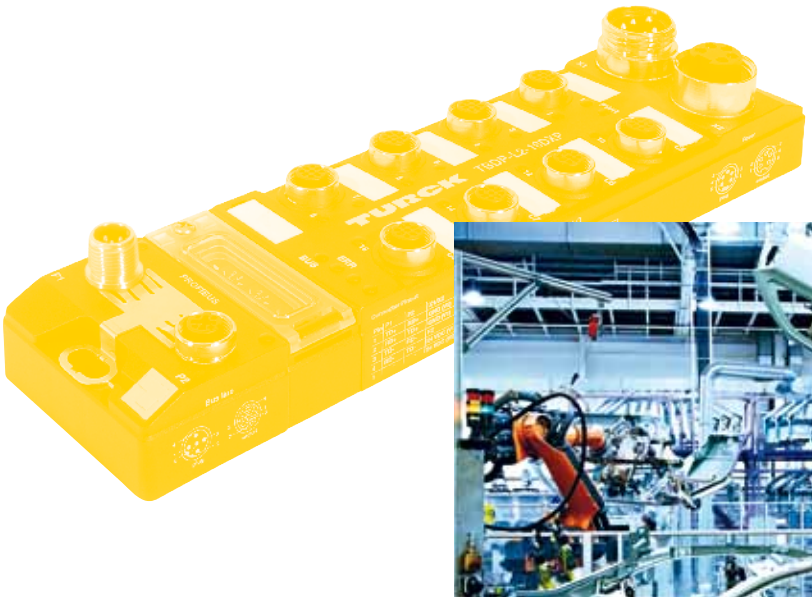
TURCK

Industrial Automation

USER MANUAL

TBEN-L/TBDP-L Compact IO modules for Ethernet/ PROFIBUS-DP



Sense it! Connect it! Bus it! Solve it!

Edition 05/2014

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1 About this manual

1.1 Documentation concept

This manual contains all information about the product families TBEN and TBDP, the TURCK block I/Os in protection class IP65/IP67/IP69K.

TBEN-L:
Compact I/O-modules for Ethernet with multiprotocol functionality ((EtherNet/IP™, Modbus TCP and PROFINET).

TBDP-L:
Compact I/O-modules for PROFIBUS-DP

The following chapters contain:

- the general technical data and station properties,
- a description of the function and the features of the single devices in this type series
- a description of the stations' representation in the different Ethernet-protocols,
- a description of the devices' handling in the different PLC-applications,

1.2 Explanation of symbols used

1.2.1 Warnings

Action-related warnings are placed next to potentially dangerous work steps and are marked by graphic symbols. Each warning is initiated by a warning sign and a signal word that expresses the gravity of the danger. The warnings have absolutely to be observed.

DANGER!

DANGER indicates an immediately dangerous situation, with high risk, the death or severe injury, if not avoided.

WARNING!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.

CAUTION!

CAUTION indicates a potentially dangerous situation with low risk, middle or low injury, if not avoided.

ATTENTION!

ATTENTION indicates a situation that may lead to property damage, if it is not avoided.

1.2.2 Further notes

NOTE

In NOTES you find tips, recommendations and important information. The notes facilitate work, provide more information on specific actions and help to avoid overtime by not following the correct procedure.

TECHNICAL BASICS

The TECHNICAL BASICS offer technical information, basics and background information. This information lead to a better understanding of the device functions for example. The experienced user can skip this information.

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

➥ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3 General notes

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual includes all information necessary for the prescribed use of the TBEN-L and TBDP-L-stations. It has been specially conceived for personnel with the necessary qualifications.

1.3.1 Prescribed use

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

1.3.2 Notes concerning planning/installation of this product

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

2 General Information

2.1 Safety Applications

At the moment, TURCK does not offer TBEN/TBDP-modules for Safety applications.

2.2 Safety in the web server

In the web server, a default-password is assigned in the TBEN-L-module for the administrator access (see also Change Admin Password (page 8-8)).

In order to make misuse by third parties more difficult, it can be necessary to change the password.

This should be done in the context of the network security concept for the complete facility in which the modules are placed.

2.2.1 Webserver-logout

In order to disconnect a logged in user/PC with administrator rights from the web server, a logout is necessary.

If only the web browser is closed, the last active access is reactivated when opening the web server again from the same PC, which means, possibly with all administrator rights.

2.3 PROFIenergy

Not supported at the moment.

3 General technical data

3.1 General

This chapter contains device-independent data such as dimensions, general technical data, etc. for the stations of the product lines TBEN-L and TBDP-L.

NOTE

Station-specific information can be found in the single station descriptions within the respective chapters of this manual.

3.2 General information on TBEN-L

The devices of the TBEN-L product family provide the following features:

- direct connection of up to 16 digital in- and outputs to the field bus
- protocols: EtherNet/IP™, Modbus TCP and PROFINET RT in one single device
- channel-related short-circuit diagnosis of outputs and slot-related short-circuit diagnosis of the sensor/actuator supply voltage
- Ethernet-connection with two 4-pole, d-coded M12 x 1 connectors
- integrated Ethernet-switch for building up a line-topology

3.3 General information on TBDP-L

The devices of the TBDP-L product family provide the following features:

- direct connection of up to 16 digital in- and outputs to the field bus
- channel-related short-circuit diagnosis of outputs and slot-related short-circuit diagnosis of the sensor/actuator supply voltage
- PROFIBUS-DP-connection with two 5-pole, b-coded M12 x 1 connectors

3.4 General technical data

3.4.1 Technical data

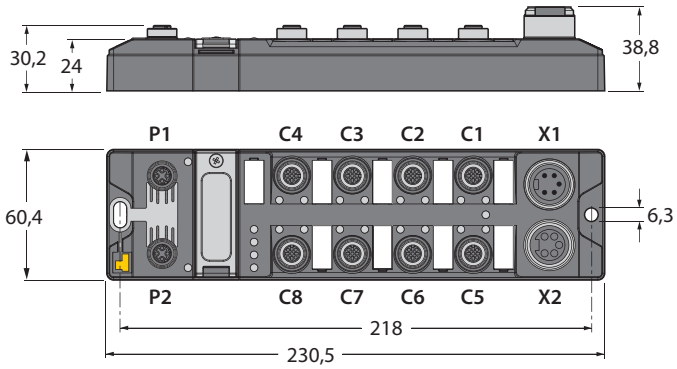
Table 3-1: Technical data of the TBxx-stations

Supply voltage	
V1 (incl. electronics supply)	24 V DC
Permissible range	18 … 30 V DC
V2	24 V DC
Permissible range	18 … 30 V DC
Electrical isolation	galvanic isolation between V1 and V2
Connectors	
Ethernet	2 x M12-female (OUT), 4-pole, D-coded
PROFIBUS	1 x M12-male (IN), 5-pole, B-coded 1 x M12-female (OUT), 5-pole, B-coded
Power supply	7/8" connector, 4-/5-pole
Inputs / Outputs	M12-connector, 5-pole
Isolation voltages	
V1 to V2	≥ 500 V AC
V1/V2 to field bus	≥ 500 V AC
Protocol properties	
Modbus TCP	
Address assignment	Static IP (rotary coding switch), BOOTP, DHCP
Supported Function Codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of connections	8
EtherNet/IP™	
address assignment	according to EtherNet/IP™ standard
Quick Connect (QC)	< 150 ms
Device Level Ring (DLR)	supported
Number of connections	3
PROFINET	
Address assignment	DCP
MinCycleTime	1 ms

Fast Start-Up (FSU)	< 150 ms
Diagnosis	according to PROFINET Alarm Handling
Topology detection	supported
Automatic address assignment	supported
Media Redundancy Protocol (MRP)	supported
Housing	Fibre-glass reinforced Polyamide (PA6-GF30)
Size	60.4 × 230.4 × 24 mm (B × L × H)
Window material	Lexan
Screw material	303 Stainless Steel
halogen-free	yes
Mounting	via 2 through-holes, Ø 6.3 mm
Mounting distance station to station	≥ 50 mm Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting). In case of low simultaneity factors and low ambient temperatures, mounting distances of < 50 mm may be possible.
Protection class	IP65/IP67/IP69K
Tests	
Vibration test	according to EN 60068-2-6/ IEC 68-2-47 Acceleration up to 20 g
Drop and topple	according to IEC 60068-2-31/ IEC 60068-2-32 1
Shock test	according to EN 60068-2-27
EMC	according to EN 61131-2
Temperature range	
– Operating temperature	- 40 °C to + 70 °C (- 40 °F to + 158 °F)
– Storage temperature	- 40 °C to + 70 °C (- 40 °F to + 158 °F)

3.4.2 Dimension drawing

Figure 3-1: Dimensions for the TBxx-stations



4 Connection options at the gateway

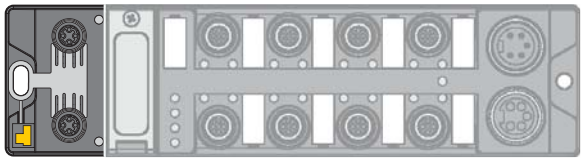
4.1 Field bus

4.1.1 Connection to Ethernet

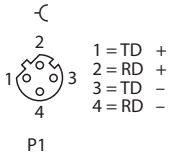
The connection to Ethernet is realized via the integrated auto-crossing switch is done using two 4-pole, D-coded M12 x 1-Ethernet-connectors.

Figure 4-1: Pin assignment of M12 x 1-Ethernet-female connectors, 4-pole

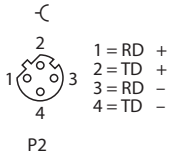
Ethernet M12 x 1



ETH1 (P1)



ETH2 (P2)



Ethernet connection for QC-/FSU-applications

NOTE

Please observe the following for QuickConnect (QC)- and Fast Start-Up (FSU)-applications:

– **do not use** a crossover-cable
– ETH1 = connector for **incoming** Ethernet-line
– ETH2 = connector for **outgoing** Ethernet-line

Further information concerning QuickConnect and FSU can be found here:

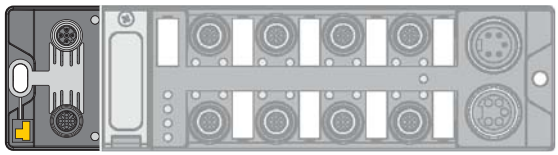
- QuickConnect in TBEN-L (page 6-33)
- FSU - Fast Start-Up (prioritized startup) (page 6-65)

4.1.2 Connection to PROFIBUS

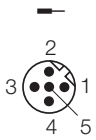
PROFIBUS-DP-connection with two 5-pole, b-coded M12 x 1 connectors

Figure 4-2: Pin assignment of M12 x 1-Ethernet-female connectors, b-coded

PROFIBUS M12 x 1

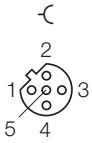


BUS IN (P1), male connector



1 = 5 V
2 = BUS-A
3 = GND
4 = BUS-B
5 = n.c.
Flansch = Schirm

BUS OUT (P2), female connector



4.2 Supply voltages

4.2.1 Pin assignment

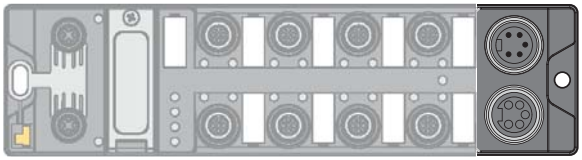
The power supply is realized via 7/8" male connectors on the module.

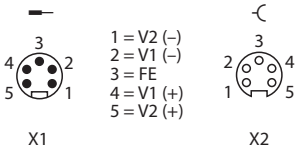
- TBEN-L1 series: 5-pole
- TBDP-L2 series: 5-pole
- TBEN-L4 line: 4-pole

V1 and V2 are galvanically isolated.

Figure 4-3: Power supply

Supply voltage 7/8“, 5-pole

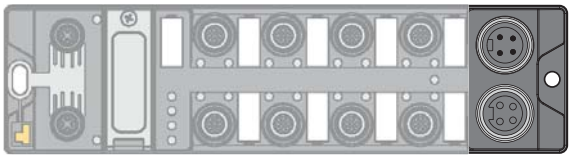


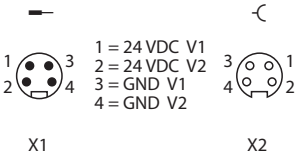


X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

Supply voltage 7/8“, 4-pole





X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

NOTE

V1 and V2 are fed and monitored separately. In case of an undercut of the admissible voltage, the connectors are switched-off according to the module's supply concept (see Supply concept (page 4-5)).

In case of an undervoltage at V2, the "POWER" LED changes from green to red. In case of an undervoltage at V1, the "POWER" LED is turned off.

4.2.2 Supply concept

All TBxx-modules are supplied via two separate voltages V1 and V2.

The I/O-channels are therefore consequently separated into the different potential groups "detachable I/O" (supplied through V2) and "non-detachable" I/O (supplied through V1).

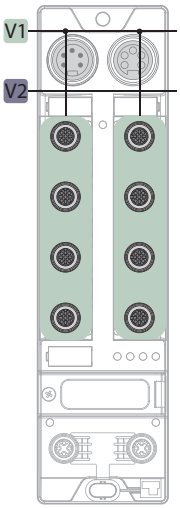
This allows a safety shutdown of parts of an installation via emergency-off circuits even when using the highly flexible 16DXP-module variants.

V1 = supply of module electronics and the respective connectors

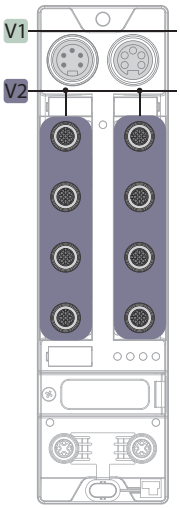
V2 = supply of module electronics and the respective connectors (separately detachable)

Figure 4-4: Module supply - overview

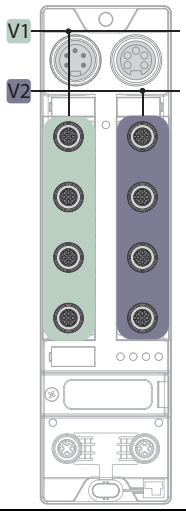
TBxx-L1-16DIP



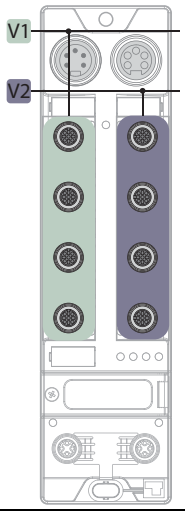
TBxx-L1-16DOP



TBxx-L1-8DIP-8DOP



TBxx-L1-16DXP

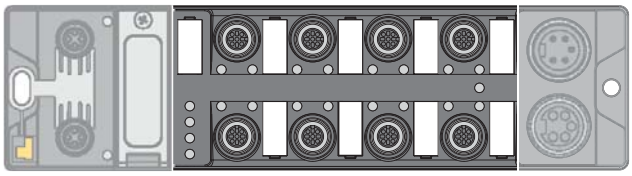


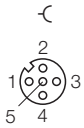
4.3 Inputs/outputs

The connection of sensors and actuators is realized via 8 M12 x 1-connectors.

Figure 4-5: M12 x 1-connectors. for in- and outputs

Inputs/outputs M12 x 1





The pin assignment and the wiring diagrams can be found in the module descriptions chapter 5, Module types.

4.4 Grounding/ shielding concept

The grounding/ shielding concept of the TBxx-modules allows the separate grounding of fieldbus- and I/O-part.

Figure 4-6: Equivalent circuit diagram shielding concept

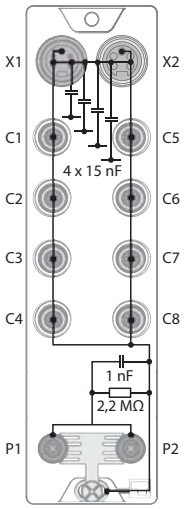
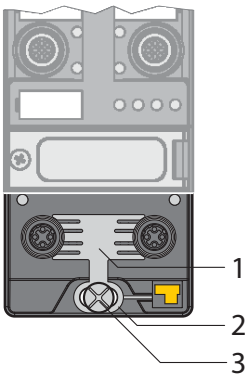


Figure 4-7: Grounding components

1 *metal clamp*
2 *metal ring*
3 *mounting screw*



The metal clamp (1) at the M12-connectors for the fieldbus connection (P1, P2) connects the shield of the fieldbus lines.

The metal ring (2) is situated under the metal clamp an connects the functional earth of the 7/8'' connectors for the voltage supply (pin 3) to the FE of the M12-connectors (pin 5) for the connection of the sensors and actuators.

By mounting the module onto a mounting plate through the mounting hole, the mounting screw is used to realize the connection to the reference potential of the installation.

4.4.1 Grounding the station (FE)

NOTE

Further information about cable routing, shielding etc. of TBxx-modules can be found in chapter 10: Guidelines for Electrical Installation.

General

Metal clamp and metal ring are connected.

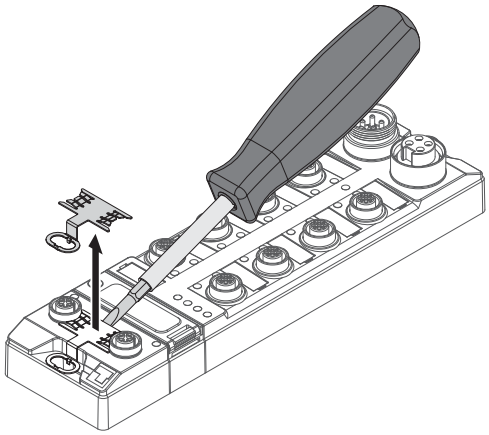
The mounting screw (3) through the station's mounting hole connects the shield of the fieldbus lines to the FE of power supply and sensors/actuators and the installation's reference potential.

If a common reference potential is not desirable, remove the metal clamp for decoupling and/or mounting the station by using a plastic screw.

Dismounting the metal clamp

➤ Use a slim slotted screwdriver in order to lift up and remove the metal clamp.

Figure 4-8: Dismounting the metal clamp

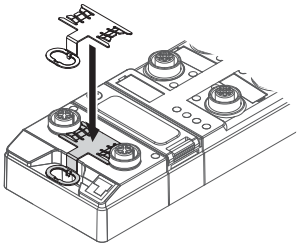


Mounting the metal clamp

➤ Place the metal clamp between the fieldbus connectors by using a screwdriver in such way that the clamp contacts the metal housing of the connectors.

➥ The shielding of the fieldbus lines is now again connected to the metal clamp.

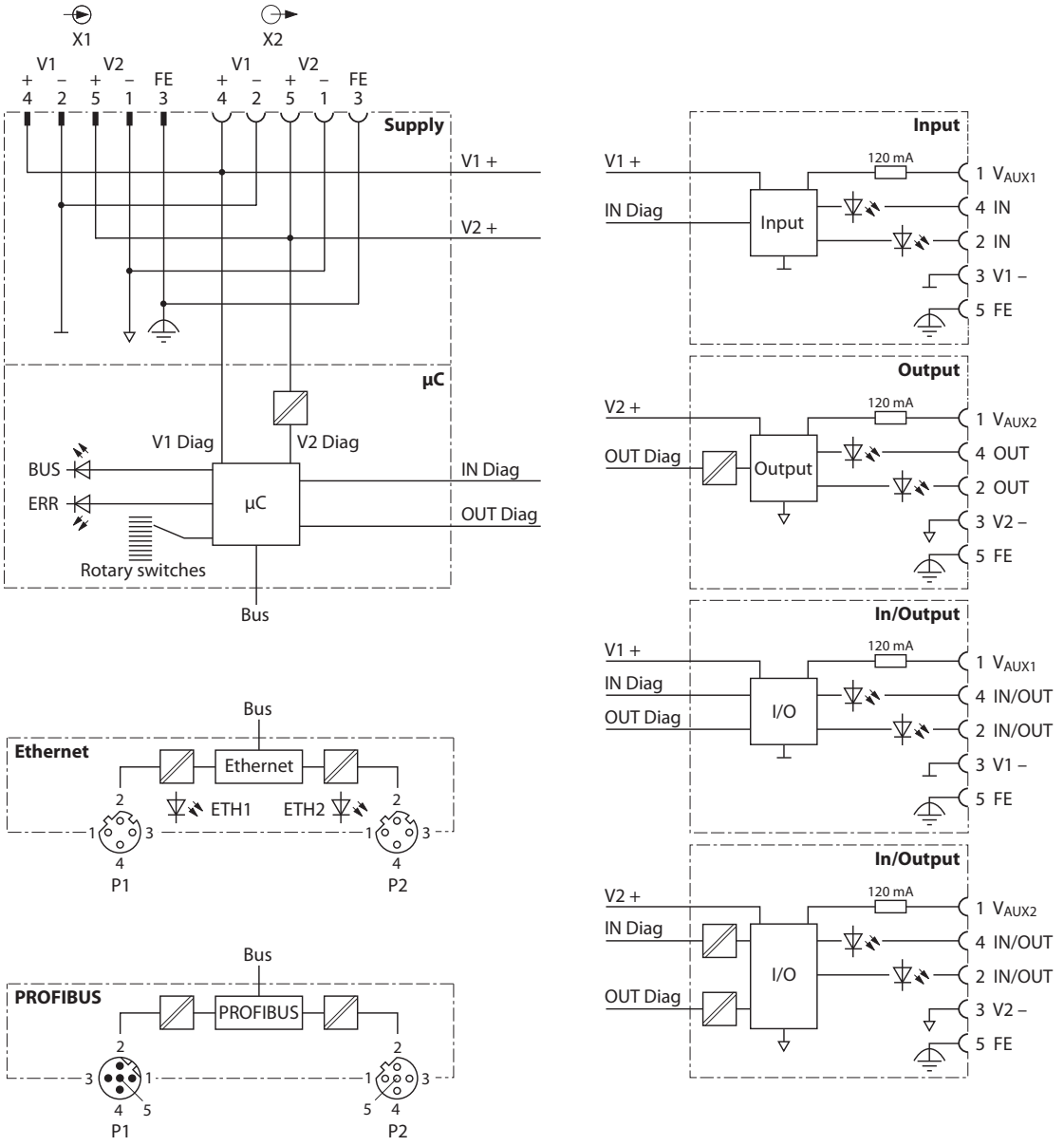
Figure 4-9: Replacing the metal clamp



5 Module types

5.1 Block diagrams TBxx

Figure 5-1: Block diagrams



5.2 TBxx-Lx-16DIP

The station offers sixteen digital inputs for 3-wire PNP sensors.

5.2.1 Technical data

Table 5-1: Technical data TBxx-Lx-16DIP

Type designation	TBxx-Lx-16DIP
Power supply	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operational current (from V_1)	< 150 mA
Sensor/actuator supply $VAUX_1$	Supply connector C1-C8 from V1 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	16
Input type	PNP
Switching threshold	EN 61131-2 type 3, PNP
Low level signal voltage	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Switch-on delay	2.5 ms
Type of input diagnostics	channel diagnostics
Electrical isolation	galvanic isolation to the field bus

NOTE

General technical data concerning the products of the TBxx-Lx-series can be found in chapter 3.

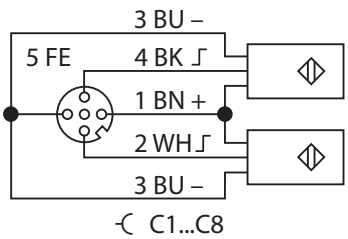
5.2.2 Wiring diagrams

→ Field bus (page 4-2)

→ Supply voltages (page 4-4)

Inputs

Figure 5-2: Inputs, pin assignment



5.2.3 Parameters

Table 5-2: Parameters

A *default setting*

Parameter name	Value	Description
Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	Inverts the digital input signal.
Pulse stretching input	0 - 255	Stretching of the input signal from 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) example: 10 = pulse of 100 ms

Further information about the parameters can be found in the fieldbus specific chapters.

TBEN-L

- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- PROFINET: Parameters (page 6-71)

TBDP-L

chapter 7.4, Parameterization (page 7-8)

5.2.4 Diagnostic messages

Table 5-3: Diagnostic messages

Diagnosis	Description
SCSx	Overload of the supply voltage at the respective connector

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

TBEN-L

- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- PROFINET: PROFINET-diagnostics (page 6-67)

TBDP-L

chapter 7.3, Diagnostics (page 7-5)

5.3 TBxx-Lx-16DOP

The station offers sixteen digital inputs for DC actuators.

5.3.1 Technical data

Table 5-4: Technical data TBxx-Lx-16DOP

Type designation	TBxx-Lx-16DOP
Power supply	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operational current (from V_1)	< 150 mA
Sensor/actuator supply $VAUX_2$	Supply connector C1-C8 from V2, 120 mA per connector, short-circuit proof
Digital outputs	
Number of channels	16
Output type	PNP
Output voltage	24 VDC from potential group
Load type	ohmic, inductive, lamp load
Simultaneity factor	0,28 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnostics
Electrical isolation	galvanic isolation to the field bus

NOTE

General technical data concerning the products of the TBxx-Lx-series can be found in chapter 3.

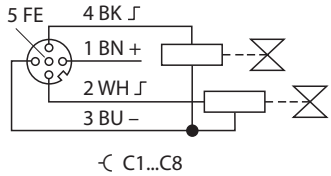
5.3.2 Wiring diagrams

→ Field bus (page 4-2)

→ Supply voltages (page 4-4)

Outputs

Figure 5-3: Outputs, pin assignment



5.3.3 Parameters

Table 5-5: Parameters

Parameter name	Value	Description
Manual output reset after overcurrent (SROx)	0 = no **A**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off after an overload until a new set-command is given (rise and fall).

A *default setting*

Further information about the parameters can be found in the fieldbus specific chapters.

TBEN-L

- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- PROFINET: Parameters (page 6-71)

TBDP-L

chapter 7.4, Parameterization (page 7-8)

5.3.4 Diagnostic messages

Table 5-6: Diagnostic messages

Diagnosis	Description
SCSx	Overload of the supply voltage at the respective connector
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

TBEN-L

- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- PROFINET: PROFINET-diagnostics (page 6-67)

TBDP-L

chapter 7.3, Diagnostics (page 7-5)

5.4 TBxx-Lx-8DIP-8DOP

The station offers eight digital inputs for 3-wire PNP-sensors and eight digital outputs for DC actuators.

5.4.1 Technical data

Table 5-7: Technical data TBxx-Lx-8DIP-8DOP

Type designation	TBxx-Lx-8DIP-8DOP
Power supply	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operating current	< 150 mA
Sensor/actuator supply V_{AUX1}/V_{AUX2}	supply of connectors C1 - C4 from V1 C5 - C8 from V2 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	8
Input type	PNP
Switching threshold	EN 61131-2 type 3, PNP
Low level signal voltage	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Switch-on delay	2.5 ms
Type of input diagnostics	channel diagnostics
Digital outputs	
Number of channels	8
Output type	PNP
Output voltage	24 VDC from potential group
Load type	ohmic, inductive, lamp load
Simultaneity factor	0,56 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnostics
Electrical isolation	galvanic isolation to the field bus

NOTE

General technical data concerning the products of the TBxx-Lx-series can be found in chapter 3.

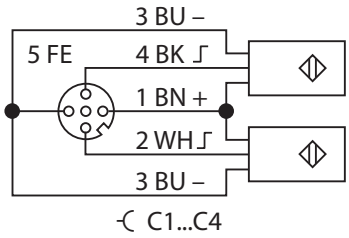
5.4.2 Wiring diagrams

→ Field bus (page 4-2)

→ Supply voltages (page 4-4)

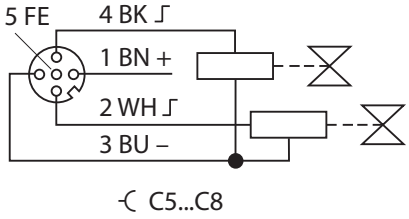
Inputs

Figure 5-4: Inputs, pin assignment



Outputs

Figure 5-5: Outputs, pin assignment



5.4.3 Parameters

Table 5-8: Parameters

A *default setting*

Parameter name	Value	Description
Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	Inverts the digital input signal.
Pulse stretching input	0 - 255	Stretching of the input signal from 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) example: 10 = pulse of 100 ms
Manual output reset after overcurrent (SROx)	0 = no **A**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off after an overload until a new set-command is given (rise and fall).

Further information about the parameter data mapping can be found in the fieldbus specific chapters.

TBEN-L

- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- PROFINET: Parameters (page 6-71)

TBDP-L

chapter 7.4, Parameterization (page 7-8)

5.4.4 Diagnostic messages

Table 5-9: Diagnostic messages

Diagnosis	Description
SCSx	Overload of the supply voltage at the respective connector
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

TBEN-L

- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- PROFINET: PROFINET-diagnostics (page 6-67)

TBDP-L

chapter 7.3, Diagnostics (page 7-5)

5.5 TBxx-Lx-16DXP

The station is equipped with sixteen channels, which can be configured individually, depending on the specific application requirements. Up to sixteen 3-wire PNP sensors or sixteen PNP DC actuators with a maximum output current of 2 A per output can be connected.

5.5.1 Technical data

Table 5-10: Technical data TBxx-Lx-16DXP

Type designation	TBxx-Lx-16DXP
Power supply	24 V DC from operating voltage
Permissible range	18 … 30 V DC
Operating current	< 150 mA
Sensor/actuator supply V_{AUX1}/V_{AUX2}	supply of connectors C1 - C4 from V1 C5 - C8 from V2 120 mA per connector, short-circuit proof
Digital inputs	
Number of channels	16
Input type	PNP
Switching threshold	EN 61131-2 type 3, PNP
Low level signal voltage	< 5 V
High level signal voltage	> 11 V
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Switch-on delay	2.5 ms
Type of input diagnostics	channel diagnostics
Digital outputs	
Number of channels	16, DC actuators
Output type	PNP
Output voltage	24 VDC from potential group
Load type	ohmic, inductive, lamp load
Simultaneity factor	0,56 for entire module, total current max. 9 A per module
Type of output diagnostics	channel diagnostics
Electrical isolation	galvanic isolation to the field bus

NOTE

General technical data concerning the products of the TBxx-Lx-series can be found in chapter 3.

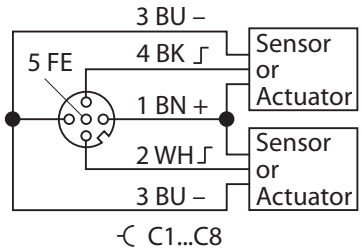
5.5.2 Wiring diagrams

→ Field bus (page 4-2)

→ Supply voltages (page 4-4)

Analog inputs and outputs

Figure 5-6: Inputs/outputs, pin assignment



5.5.3 Parameters

Table 5-11: Parameters

A *default setting*

Parameter name	Value	Description
Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	The digital input signal is inverted.
Pulse stretching input	0 - 255	Stretching of the input signal from 10 to 2550 ms. Default setting: 0 = pulse stretching deactivated (standard pulse = 2,5 ms) example: 10 = pulse of 100 ms
Manual output reset after overcurrent (SROx)	0 = no **A**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off and on again.
Activate output (EN DOx)	0 = no	
	1 = yes **A**	

Further information about the parameter data mapping can be found in the fieldbus specific chapters.

TBEN-L

- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- PROFINET: Parameters (page 6-71)

TBDP-L

chapter 7.4, Parameterization (page 7-8)

5.5.4 Diagnostic messages

Table 5-12: Diagnostic messages

Diagnosis	Description
SCSx	Overload of the supply voltage at the respective connector
SCOx	Overcurrent at the respective output

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

TBEN-L

- Modbus TCP: Register mapping of the TBEN-L stations (page 6-21) ff.
- EtherNet/IP™: Digital Versatile Module Class (VSC117) (page 6-60) ff.
- PROFINET: PROFINET-diagnostics (page 6-67)

TBDP-L

chapter 7.3, Diagnostics (page 7-5)

6 Module family TBEN-L

6.1 Configuration

This sub-chapter describes the configuration of the Ethernet-connection.

Details concerning the necessary protocol-specific configurations (Modbus TCP, EtherNet/IP™, PROFINET) can be found in the respective sub-chapters.

6.1.1 Device configuration files

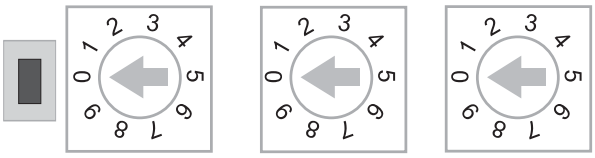
The actual device configuration files for the stations can be downloaded from the TURCK-website www.turck.com.

Information about the protocol-specific files can be found in the respective sub-chapters.

6.1.2 Address assignment Ethernet

Setting the address mode is done through the 3 rotary coding-switches on the gateway.

Figure 6-1: Decimal rotary coding-switches for address setting



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
900: F_Reset

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not warranted
➤ Screw the protective cover over the rotary coding-switches firmly
➤ Check if seal of the protective cover is correctly placed

NOTE

After every change of the address-mode, a voltage reset must be done.

Mode: Static rotary

- switch position: **001 - 254**

When using the rotary-mode, the last byte of the station's IP address can be set via the rotary coding switches.

Addresses in the range from 0 to 255 can be allocated, whereas 1 is normally reserved for the default-gateway and 0 and 255 for broadcast messages in the subnet.

In TURCK devices, 0 is used to reset the device to the default IP address (see Resetting the IP address, switch position "000" (page 6-5)).

NOTE

We therefore recommend addresses in the range of 2-254.

Mode: BootP (300)

- switch position: 300

Address setting is carried out by a BootP-server in the network after the start-up of the gateway.

NOTE

The IP address, as well as the default subnet mask assigned to the station by the BootP-server, are stored permanently in the station's EEPROM.

In case of switching the device to rotary- or PGM-mode, the settings carried out via BootP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

Mode: DHCP (400)

- switch position: 400

Address setting is carried out by a DHCP-server in the network after the start-up of the gateway.

NOTE

The IP address, as well as the default subnet mask assigned to the station by the DHCP-server, are stored permanently in the station's EEPROM.

In case of switching the device to rotary- or PGM-mode, the settings carried out via DHCP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

DHCP supports three mechanisms for IP address allocation:

- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time, or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

Mode: PGM (500)

- switch position: 500

The PGM-mode enables access of the software I/O-ASSISTANT to the module's network settings.

NOTE

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are send to the module's internal EEPROM and stored permanently.

Mode: PGM-DHCP (600)

- switch position: 600

The device sends DHCP-requests until a IP address is assigned (DHCP-server, PROFINET-controller).

The assigned IP-address is stored to the device and the DHCP-client is stopped.

Even after a restart of the device, the device sends no further DHCP-requests.

PROFINET

This mode assures a PROFINET-compliant operation of the modules.

NOTE

If a DHCP-server is used within the network, problems may occur during IP-assignment.

In this case, both, the DHCP-server as well as the PROFINET-controller (via DCP), try an IP-address-assignment.

6.1.3 Resetting the IP address, switch position "000"

With this setting the rotary coding-switches to "000" followed by a voltage reset, the module is set to the address 192.168.1.254 for IP-based services (seeDefault setting of the gateway (page 6-5)).

NOTE

Setting "000" is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

Default setting of the gateway

The stations' default-settings are as follows:

IP address	192.168.1.254
Subnet mask	255.255.255.0
default gateway	192.168.1.1

NOTE

The stations can be reset by the user to these default settings at any time.
To reset the module, set the 3 coding-switches on the gateway to "000" followed by a power-on reset.

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not warranted
➤ Screw the protective cover over the rotary coding-switches firmly
➤ Check if seal of the protective cover is correctly placed

6.1.4 Factory reset (F_Reset), switch position „900“

F_Reset (Reset to factory setting)

switch position: 900

This mode sets all device-settings back to the default values and deletes all data in the device's internal flash.

NOTE

Setting 900 is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

ATTENTION!

Protective cover opened

Protection class IP65/IP67/IP69K not warranted

➤ Screw the protective cover over the rotary coding-switches firmly

➤ Check if seal of the protective cover is correctly placed

6.1.5 Functional difference: switch position "000" and "900"

Table 6-1: Functional difference "000" and "900"

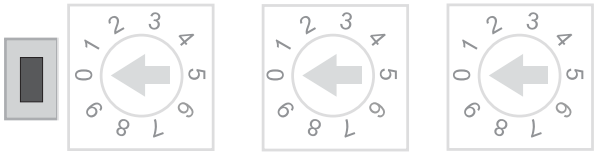
Reset of...	Switch position	
	000	**900**
IP address, subnet mask, gateway	✓	✓
Parameters	-	✓
PROFINET device name	-	✓

6.1.6 Set-button

The Set-button is placed left to the rotary coding switches under the cover at the device.

Pushing the Set-button causes a device-restart.

Figure 6-2: Set-button



ATTENTION!

Protective cover opened

Protection class IP65/IP67/IP69K not warranted

➤ Screw the protective cover over the rotary coding-switches firmly

➤ Check if seal of the protective cover is correctly placed

6.1.7 Addressing via PACTware™ - I/O-ASSISTANT 3 (FDT/DTM)

The software-tool I/O-ASSISTANT enables direct access to the Ethernet-network via the Ethernet cable.

The IP address, as well as the subnet mask of the TURCK Ethernet stations, can be changed according to the application by using the Busaddress Management function of the BL Service Ethernet interface (TCP/IP) in the software I/O-ASSISTANT.

Further information about using this software can be found in chapter 9: Access via I/O-ASSISTANT 3 (FDT/DTM), PACTware (page 9-1).

6.1.8 Addressing via web server

The device's network settings can be changed under "Network Configuration" only by users having administrator rights.

Further information concerning the web server of the TBEN-L devices and it's use can be found under chapter 8, The web server (page 8-1).

6.2 Module status

6.2.1 LED behavior

The following table describes the protocol-independent behavior of the module LEDs.

The description of protocol-specific LED-behavior can be found in the respective sub-chapters.

Table 6-2: LED-displays of TBEN-L stations

LED	Color	Status	Meaning	Remedy
PWR				
TBEN-Lx-16DIP	green	off	V1 missing or < 18 V DC	Check V1
		on	V1 OK	
TBEN-Lx-16DOP TBEN-Lx-8DIP-8DOP TBEN-Lx-16DXP	green	off	V1 missing or < 18 V DC	Check V1
		on	V1 and V2 OK	-
	red	on	V2 missing or < 18 V DC	Check V2
ETHx	green	on	Link established, 100 Mbps	
		flashing	Ethernet Traffic, 100 Mbps	
	yellow	on	Link established, 10 Mbps	
		flashing	Ethernet Traffic, 10 Mbps	
		off	No Ethernet link.	Check the Ethernet-connection
ERR	green	on	No diagnostic message available	
	red	on	Diagnostic message pending	
BUS	green	on	Active connection to a master	-
		flashing	Device is ready for operation	-
	red	on	IP address conflict or restore mode or timeout	control IP addresses in the network waiting for the device to be ready for operation
		flashing	Blink-/wink-command active	-
	red / green	on	Autonegotiation and/or waiting for DHCP-/BootP-address assignment.	

Table 6-2: LED-displays of TBEN-L stations

A *can also occur in combination*

LED	Color	Status	Meaning	Remedy
1 to 16				
TBDP-Lx-16DIP	green	flashing **A**	Input active, 24 V at input	
	red	flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Input inactive	
TBEN-Lx-16DOP	green	flashing **A**	Output active	
	red	on	Output active, overload/overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output inactive	
TBEN-Lx-16DXP	green	flashing **A**	Output or input active	
	red	on	output active, overload/overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output or input active	
1 to 8				
TBEN-Lx-8DIP-8DOP	green	flashing **A**	Input active, 24 V at input	
	red	flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off		

Table 6-2: LED-displays of TBEN-L stations

LED	Color	Status	Meaning	Remedy
9 to 16				
TBEN-Lx-8DIP-8DOP	green	flashing **A**	Output active	
	red	on	Output active, overload/overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output inactive	

6.2.2 Status and Control Word of the TBEN-L stations

The Status as well as the Control Word are mapped into the station's process data.

- EtherNet/IP™
  In EtherNet/IP™, the mapping can be disabled (see Gateway Class (VSC 100), GW Status Register (page 6-58) and GW Control Register (page 6-58)).

ATTENTION!

Activate/deactivate the Status and Control Word in EtherNet/IP™

Changes in the process data mapping

➤ Observe that activating/deactivating the Status and Control Word causes changes in the process data mapping.

- Modbus TCP
  → see Register 100Ch: „Station-Status“ (page 6-26)
- PROFINET
  → see PROFINET-diagnostics (page 6-67)

Status Word

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V1	-

Meaning of the status bits

Table 6-3: Meaning of the status bits

Name	Meaning
Diag Warn	Group diagnostics of the device. At least 1 channel sends diagnostics.
V2	V2 too low (< 18 V DC).
V1	V2 too low (< 18 V DC).
COM	I/O Communication Lost Error No Communication on the module bus.
CFG	I/O Cfg Modified error The I/O-configuration has be changed and is no longer compatible.
FCE	Force Mode Active Error The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.

Control Word

The Control Word has no function at the moment, it is reserves for further use.

6.3 Protocols

6.3.1 Multi protocol functionality

General

The compact I/O-stations of the TBEN-L product line combine the three Ethernet-protocols:

- Modbus TCP (description page 6-13 ff.),
- EtherNet/IP™ (description page 6-30) and
- PROFINET (description page 6-3 ff.)

in one device.

A multi-protocol device can be operated without intervention of the user (which means, without changes in the parameterization) in all of the three Ethernet protocols mentioned.

During the start-up, after a power-on, the module runs in "snooping" mode and detects the Ethernet protocol which requests a link connection by listening the traffic.

If a protocol is detected, the device is set automatically to the respective protocol. After this an access to the device from other protocols is read-only.

6.3.2 Explicit/manual protocol selection

The protocol can also be determined manually. This skips the snooping-phase and the device is permanently set to the selected protocol. An access to the device from other protocols is read-only.

The explicit protocol selection allows thus an additional locking mechanism.

6.3.3 Protocol dependent functions

PROFINET

- Fast Start-UP (FSU), see FSU - Fast Start-Up (prioritized startup) (page 6-65)
- Topology discovery
- Address assignment via LLDP
- MRP, see MRP (Media Redundancy Protocol) (page 6-66)

EtherNet/IP™

- QuickConnect (QC), see QuickConnect in TBEN-L (page 6-33)
- DLR (Device Level Ring), see Device Level Ring (DLR) (page 6-34)

6.4 Modbus TCP

Common Modbus description

NOTE

The following description of the Modbus protocol is taken from the Modbus Application Protocol Specification V1.1 of Modbus-IDA.

TECHNICAL BASICS

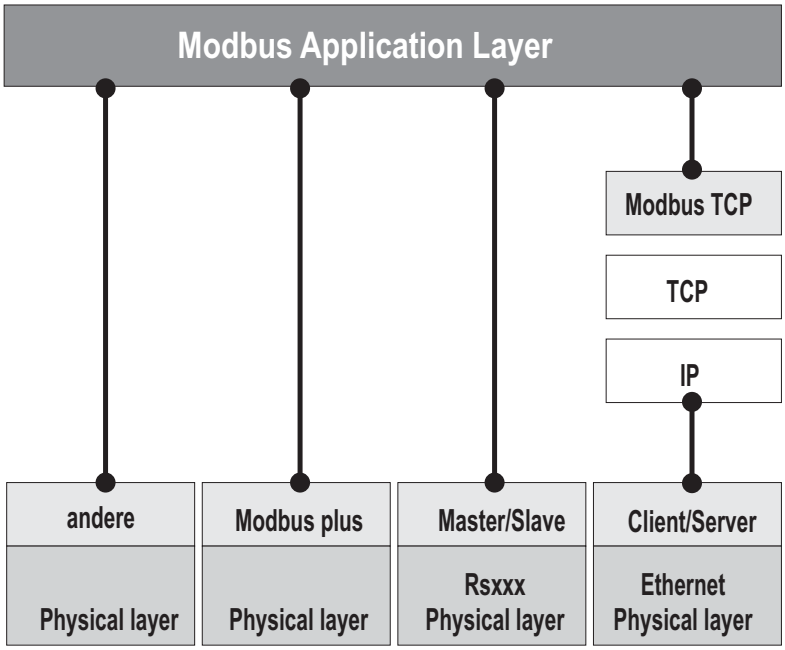
Modbus is an application layer messaging protocol, positioned at level 7 of the OSI model, that provides client/server communication between devices connected on different types of buses or networks.

The industry's serial de facto standard since 1979, Modbus continues to enable millions of automation devices to communicate. Today, support for the simple and elegant structure of Modbus continues to grow.

The Internet community can access Modbus at a reserved system port 502 on the TCP/IP stack.
Modbus is a request/reply protocol and offers services specified by function codes. Modbus function codes are elements of Modbus request/reply PDUs (Protocol Data Unit).

It is currently implemented using:
– TCP/IP over Ethernet. (that is used for the TBEN-L modules and described in the following)
– Asynchronous serial transmission over a variety of media (wire: RS232, RS422, RS485, optical: fiber, radio, etc.)
– Modbus PLUS, a high speed token passing network.

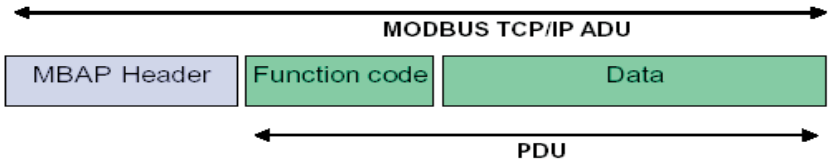
Schematic representation of the Modbus Communication Stack (according to Modbus Application Protocol Specification V1.1 of Modbus-IDA):



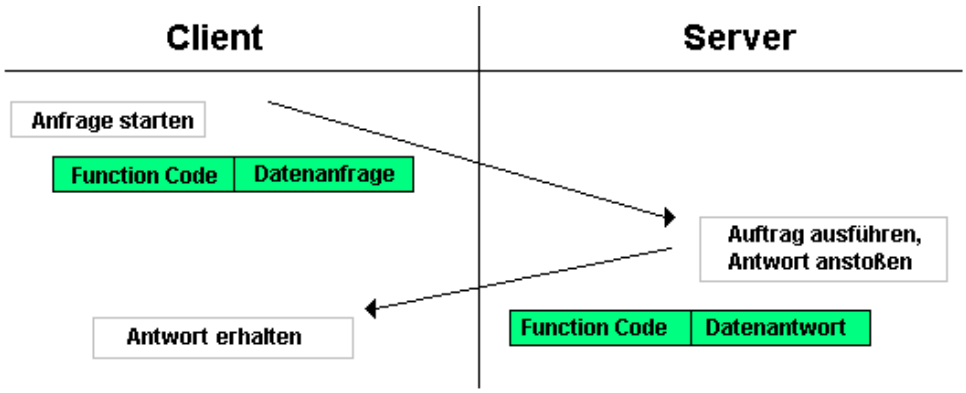
Protocol description

TECHNICAL BASICS

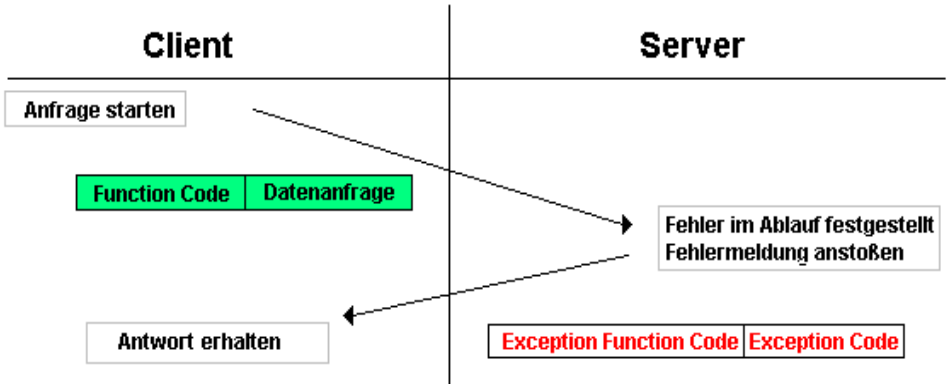
The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers.
The mapping of Modbus protocol on specific buses or network can introduce some additional fields on the application data unit (ADU).
The Modbus application data unit is built by the client that initiates a Modbus transaction.
The function code indicates to the server what kind of action to perform.
The Modbus application protocol establishes the format of a request initiated by a client.
The field function code of a Modbus data unit is coded in one byte. Valid codes are in the range of 1... 255 decimal (128 – 255 reserved for exception responses).
When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid.
Sub-function codes are added to some function codes to define multiple actions.



The data field of messages sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the data field.
The data field may be non-existent (= 0) in certain kinds of requests, in this case the server does not require any additional information. The function code alone specifies the action.
If no error occurs related to the Modbus function requested in a properly received Modbus ADU the data field of a response from a server to a client contains the data requested.



If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.



Data model

The data model distinguishes four basic data types:

Table 6-4: Data types for Modbus

Data Type	Object type	Access	Comment
Discrete Inputs	bit	Read	This type of data can be provided by an I/O system.
Coils	bit	Read-Write	This type of data can be alterable by an application program.
Input Registers	16 bit, (word)	Read	This type of data can be provided by an I/O system.
Holding Registers	16 bit, (word)	Read-Write	This type of data can be alterable by an application program.

TECHNICAL BASICS

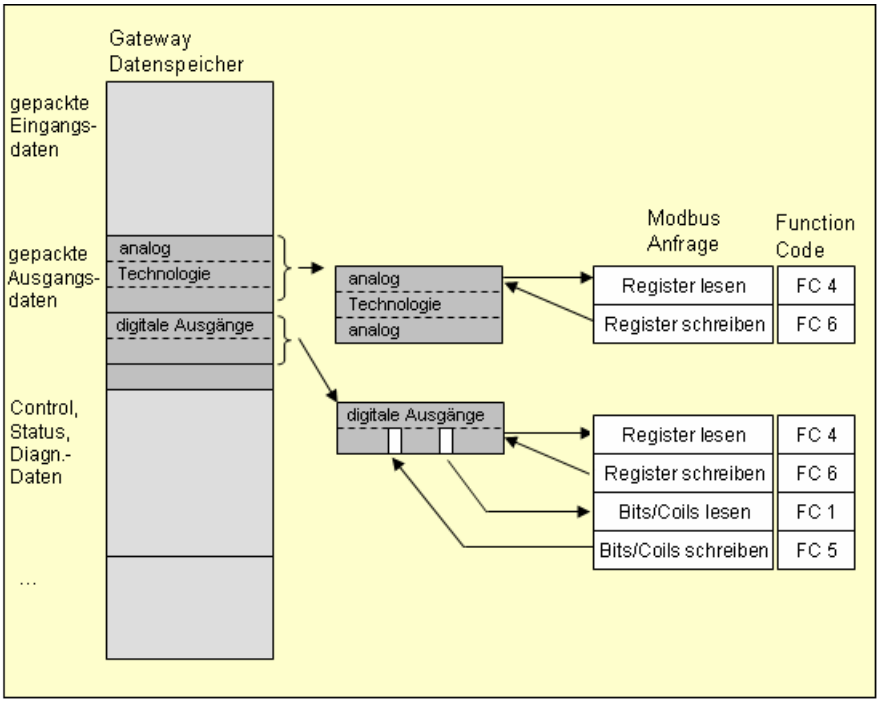
For each of these basic data types, the protocol allows individual selection of 65536 data items, and the operations of read or write of those items are designed to span multiple consecutive data items up to a data size limit which is dependent on the transaction function code.
It's obvious that all the data handled via Modbus (bits, registers) must be located in device application memory.

Access to these data is done via defined access-addresses (see Modbus-registers (page 6-18)).

The example below shows the data structure in a device with digital and analog in- and outputs.

TBEN-L devices have only one data block, which can be accessed via different Modbus functions. The access can be carried out either via registers (16-bit-access) or, for some of them, via single-bit-access.

Figure 6-3: Picture of the data memory of the TBEN-L modules



6.4.1 Implemented Modbus functions

The TBEN-L stations for Modbus TCP support the following functions for accessing process data, parameters, diagnostics and other services.

Table 6-5: Implemented functions

Function codes	
No.	**Function**
	Description
1	**Read Coils**
	Serves for reading multiple output bits.
2	**Read Discrete Inputs**
	Serves for reading multiple input bits.
3	**Read Holding Registers**
	Serves for reading multiple output registers.
4	**Read Input Registers**
	Serves for reading multiple input registers.
5	**Write Single Coil**
	Serves for writing a single output bit.
6	**Write Single Register**
	Serves for writing a single output register.
15	**Write Multiple Coils**
	Serves for writing multiple output bits.
16	**Write Multiple Registers**
	Serves for writing multiple output registers.
23	**Read/Write Multiple Registers**
	Reading and writing of multiple registers.

6.4.2 Modbus-registers

NOTE

The Table 6-7: Mapping of Modbus registers (holding registers), page 6-19 shows the register mapping for the different Modbus addressing methods.

Table 6-6: Modbus registers of the station

A *ro = read only*
rw = read/write

Address (hex.)	Access A	Description
0x0000 to 0x01FF	ro	packed process data of inputs (process data length of the modules → see Table 6-8: Data widths of the stations
0x0800 to 0x09FF	rw	packed process data of outputs (process data length of the modules → see Table 6-8: Data widths of the stations
0x1000 to 0x1006	ro	Station Identifier
0x100C	ro	Station status → see Table 6-10: Register 100Ch: Station status
0x1012	ro	process image length in bit for the intelligent output modules
0x1013	ro	process image length in bit for the intelligent input modules
0x1017	ro	Register-mapping-revision (always 1, if not, mapping is incompatible with this description)
0x1020	ro	watchdog, actual time [ms]
0x1120	rw	watchdog predefined time [ms] (default: 0), → see also Error behavior (watchdog) (page 6-28)
0x1130	rw	Modbus connection mode register, page 6-27
0x1131	rw	Modbus connection timeout in sec. (Def.: 0 = never), → see page 6-27
0x113C to 0x113D	rw	Modbus parameter restore, → see page 6-27 (reset of parameters to default values)
0x113E to 0x113F	rw	Modbus parameter save, → see page 6-28 (permanent storing of parameters)
0x1140	rw	deactivate protocol Deactivates explicitly the selected Ethernet-protocol: 0 = EtherNet/IP™ 1 = Modbus TCP 2 = PROFINET 15 = web server

Table 6-6: Modbus registers of the station

Address (hex.)	Access A	Description
0x1141	ro	active protocol 0 = EtherNet/IP™ 1 = Modbus TCP 2 = PROFINET 15 = web server
0x2400	ro	V1 [mV]: 0 at < 18 V
0x2401	ro	V2 [mV]: 0 at < 18 V
0x8000 to 0x8400	ro	process data inputs (32 registers per station)
0x9000 to 0x9400	rw	process data outputs (32 registers per station)
0xA000 to 0xA400	ro	diagnostics (32 registers per station)
0xB000 to 0xB400	rw	parameters (32 registers per station)

The following table shows the register mapping for the different Modbus addressing methods

Table 6-7: Mapping of Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
packed input data	0x0000 to 0x01FF	0 to 511	40001 to 40512	400001 to 400512
Packed output data	0x0800 to 0x09FF	2048 to 2549	42049 to 42560	402049 to 402560
Station Identifier	0x1000 to 0x1006	4096 to 4102	44097 to 44103	404097 to 404103
Station status	0x100C	4108	44109	404109
process image length in bit for the digital output modules	0x1012	4114	44115	404115
process image length in bit for the digital input modules	0x1013	4115	44116	404116
watchdog, actual time	0x1020	4128	44129	404129
watchdog, predefined time	0x1120	4384	44385	404385
Modbus connection mode register	0x1130	4400	44401	404401
Modbus connection timeout in sec.	0x1131	4401	44402	404402

Table 6-7: Mapping of Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
Modbus parameter restore	0x113C to 0x113D	4412 to 4413	44413 to 44414	404413 to 404414
Modbus parameter save	0x113E to 0x113F	4414 to 4415	44415 to 44416	404415 to 404416
deactivate protocol	0x1140	4416	44417	404417
active protocol	0x1141	4417	44418	404418
V1 [mV]:	0x2400	9216	49217	409217
V2 [mV]:	0x2401	9217	49218	409218
process data inputs (max. 2 registers per station)	0x8000, 0x8001	32768 32769	-	432769 432770
process data outputs (max. 2 registers per station)	0x9000, 0x9001	36864, 36865	-	436865, 436866
Diagnostics (max. 2 registers per station)	0xA000, 00A001	40960, 40961	-	440961, 440962
Parameters (max. 4 registers per station)	0xB000, 0xB001	45056, 45057	-	445057, 445058

6.4.3 Data width of the I/O-modules in the Modbus-register area

The following table shows the data width of the TBEN-L stations within the Modbus register area and the type of data alignment.

Table 6-8: Data widths of the stations

Station	Process input	Process output	Alignment
TBEN-Lx-16DIP	16 Bit	-	bit by bit
TBEN-Lx-16DOP	-	16 Bit	bit by bit
TBEN-Lx-8DIP-8DOP	8 Bit	8 Bit	bit by bit
TBEN-Lx-16DXP	16 Bit	16 Bit	bit by bit

6.4.4 Register mapping of the TBEN-L stations

TBEN-Lx-16DIP

Register	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
0x0001 Status Word	Byte 0	-	-	-	-	-	-	-	Diag Warn
	Byte 1	-	FCE	-	-	CFG	COM	V_1	-
0x0002 group diag-nostics	Byte 0	-	-	-	-	-	-	-	I/O Diag
	Byte 1	-	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
Diagnostics									
0xA000	Byte 0	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	Byte 1	-	-	-	-	-	-	-	-
Parameters									
0xB000	Byte 0	-	-	-	-	-	-	-	-
	Byte 1	-	-	-	-	-	-	-	-
0xB001	Byte 0	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	Byte 1	Inv. DI16	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9
0xB002	Byte 0	reserved							
	Byte 1	Pulse stretching input 1							
0xB003	Byte 0	Pulse stretching input 2							
	Byte 1	Pulse stretching input 3							
0xB004	Byte 0	Pulse stretching input 4							
	Byte 1	Pulse stretching input 5							
0xB005	Byte 0	Pulse stretching input 6							
	Byte 1	Pulse stretching input 7							
0xB006	Byte 0	Pulse stretching input 8							
	Byte 1	Pulse stretching input 9							
0xB007	Byte 0	Pulse stretching input 10							
	Byte 1	Pulse stretching input 11							
0xB008	Byte 0	Pulse stretching input 12							
	Byte 1	Pulse stretching input 13							
0xB009	Byte 0	Pulse stretching input 14							
	Byte 1	Pulse stretching input 15							
0xB00A	Byte 0	Pulse stretching input 16							
	Byte 1	reserved							

→ Meaning of the register bits (page 6-25)

TBEN-Lx-16DOP

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0001 Status Word	Byte 0	V_2	-	-	-	-	-	-	Diag Warn
	Byte 1	-	FCE	-	-	CFG	COM	V_1	-
0x0002 group diag-nostics	Byte 0	-	-	-	-	-	-	-	I/O Diag
	Byte 1	-	-		-	-	-	-	-
Packed output data									
0x0800	Byte 0	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	Byte 1	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
Outputs									
0x9000	Byte 0	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	Byte 1	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
Diagnostics									
0xA000	Byte 0	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	Byte 1	SCO8	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1
0xA001	Byte 0	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
	Byte 1	-	-	-	-	-	-	-	-
Parameters									
0xB000	Byte 0	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1
	Byte 1	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
0xB000	Byte 0								
	Byte 1								

→ Meaning of the register bits (page 6-25)

TBEN-Lx-8DIP-8DOP

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	-	-		-	-	-	-	-
0x0001 Status Word	Byte 0	V_2	-	-	-	-	-	-	Diag Warn
	Byte 1	-	FCE	-	-	CFG	COM	V_1	-
0x0002 group diag-nostics	Byte 0	-	-	-	-	-	-	-	I/O Diag
	Byte 1	-	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	-	-		-	-	-	-	-
Packed output data									
0x0800	Byte 0	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
	Byte 1	-	-	-	-	-	-	-	-
Outputs									
0x9000	Byte 0	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
	Byte 1	-	-	-	-	-	-	-	-
Diagnostics									
0xA000	Byte 0	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	Byte 1	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
Parameters									
0xB000	Byte 0	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	Byte 1	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
0xB001	Byte 0	reserved							
	Byte 1								
	Byte 0								
0xB002	Byte 0	reserved							
	Byte 1	Pulse stretching input 1							
0xB003	Byte 0	Pulse stretching input 2							
	Byte 1	Pulse stretching input 3							
0xB004	Byte 0	Pulse stretching input 4							
	Byte 1	Pulse stretching input 5							
0xB005	Byte 0	Pulse stretching input 6							
	Byte 1	Pulse stretching input 7							
0xB006	Byte 0	Pulse stretching input 8							
	Byte 1	reserved							

→ Meaning of the register bits (page 6-25)

TBEN-Lx-16DXP

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Packed input data									
0x0000 Inputs	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
0x0001 Status Word	Byte 0	V_2	-	-	-	-	-	-	Diag Warn
	Byte 1	-	FCE	-	-	CFG	COM	V_1	-
0x0002 group diag-nostics	Byte 0	-	-	-	-	-	-	-	I/O Diag
	Byte 1	-	-	-	-	-	-	-	-
Inputs									
0x8000	Byte 0	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	Byte 1	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
Packed output data									
0x0800		DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
		DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
Outputs									
0x9000	Byte 0	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	Byte 1	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
Diagnostics									
0xA000	Byte 0	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	Byte 1	SCO8	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1
0xA001	Byte 0	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
	Byte 1	-	-	-	-	-	-	-	-
Parameters									
0xB000		reserved							
0xB001	Byte 0	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	Byte 1	Inv. DI6	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9
0xB002	Byte 0	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1
	Byte 1	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
0xB003	Byte 0	EN DO8	EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1
	Byte 1	EN DO10	EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9
0xB004	Byte 0	reserved							
	Byte 1	Pulse stretching input 1							
0xB005	Byte 0	Pulse stretching input 2							
	Byte 1	Pulse stretching input 3							
0xB006	Byte 0	Pulse stretching input 4							
	Byte 1	Pulse stretching input 5							
0xB007	Byte 0	Pulse stretching input 6							
	Byte 1	Pulse stretching input 7							

Register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0xB008	Byte 0	Pulse stretching input 8							
	Byte 1	Pulse stretching input 9							
0xB009	Byte 0	Pulse stretching input 10							
	Byte 1	Pulse stretching input 11							
0xB00A	Byte 0	Pulse stretching input 12							
	Byte 1	Pulse stretching input 13							
0xB00B	Byte 0	Pulse stretching input 14							
	Byte 1	Pulse stretching input 15							
0xB00C	Byte 0	Pulse stretching input 16							
	Byte 1	reserved							

→ Meaning of the register bits (page 6-25)

Meaning of the register bits

Table 6-9: Meaning of the register bits

Name	Meaning
I/O-data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = Pin
Diagnostics	
DiagWarn	see Register 100Ch: „Station-Status“ (page 6-26)
V_1	
V_2	
COM	
CFG	
FCE	
I/O Diag	Group diagnostics of I/Os
SCSx	Overload of the supply voltage at the respective connector
SCOx	Overcurrent at the respective output
Parameters	See "parameters"-section for the respective module type chapter 5.

6.4.5 Register 100Ch: „Station-Status“

This register contains a general gateway/ station status.

Table 6-10: Register 100Ch: Station status

Bit	Name	Description
Station		
15	-	-
14	FCE	The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.
13	-	-
12	-	-
Module bus		
11	CFG	I/O configuration error
10	COM	Communication on the internal module bus disturbed.
Voltage errors		
9	V_1	System supply voltage too low (< 18 V DC).
8	-	-
7	V_2	V2 too low (< 18 V DC).
6	-	-
5	-	-
4	-	-
Warnings		
3	-	-
2	-	-
1	-	-
0	DiagWarn	Diagnostic messages are available.

6.4.6 Register 1130h: „Modbus-Connection-Mode“

This register defines the behavior of the Modbus connections:

Table 6-11: Register 1130h: Modbus-Connection-Mode

Bit	Name – Description
15 to 2	reserved
1	**MB_ImmediateWritePermission** – **0**: With the first write access, a write authorization for the respective Modbus-connection is requested. If this request fails, an exception response with exception-code 01h is generated. If the request is accepted, the write access is executed and the write authorization remains active until the connection is closed. – **1**: The write authorization for the respective Modbus-connection is already opened during the establishment of the connection. The first Modbus-connection thus receives the write authorization, all following connections don’t (only if bit 0 = 1).
0	**MB_OnlyOneWritePermission** – **0**: all Modbus-connections receive the write authorization – **1**: only one Modbus-connection can receive the write permission. A write permission is opened until a Disconnect. After the Disconnect the next connection which requests a write access receives the write authorization.

6.4.7 Register 1131h: „Modbus-Connection-Timeout“

This register defines after which time of inactivity a Modbus-connection is closed through a Disconnect.

Behavior of the BUS LED

In case of a Connection Timeout the BUS LED's behavior is as follows:

Connection-Timeout	BUS LED
Time elapsed	green, flashing

6.4.8 Register 0x113C and 0x113D: „Restore Modbus-Connection-Parameters”

Register 0x113C and 0x113D are used to reset the parameter-register 0x1120 and 0x1130 to 0x113B to default.

For this purpose, write 0x6C6F to register 0×113E. To activate the reset of the registers, write 0×6164 ("load") within 30 seconds in register 0×113D.

Both registers can also be written with one single request using the function codes FC16 and FC23.

The service resets the parameters without saving them. This can be achieved by using a following "save" service.

6.4.9 Register 0x113E and 0x113F: "Save Modbus-Connection-Parameters"

Registers 0x113E and 0x113F are used for permanent storing the parameters in registers 0x1120 and 0x1130 to 0x113B.

For this purpose, write 0x7361 to register 0×113E. To activate the saving of the registers, write 0×7665 ("save") within 30 seconds in register 0×113F.

Both registers can also be written with one single request using the function codes FC16 and FC23.

6.4.10 Bit areas: mapping of input-discrete- and coil-areas

The digital in- and outputs can be read and written (for outputs) as registers in the data area of the packed in- and output process data.

NOTE

In the packed process data, the digital I/O data are stored following the variable in- and output data area of the intelligent I/Os, which means they are stored with a variable offset, depending on the station's I/O-configuration.

In order to set for example a single output (single coil), the following functions are available for reading and writing single bits:

- FC1 („Read Coils"),
- FC2 ("Read Discrete Inputs"),
- FC 5 ("Write Single Coil")
- FC15 ("Write Multiple Coils")

Data mapping in the input-discrete- and coil-areas:

- Mapping: input-discrete-area
  All digital inputs are stored in this area (offset "0").
- Mapping: Coil-area
  All digital outputs are stored in this area (offset "0").

6.4.11 Error behavior (watchdog)

Behavior of outputs

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120, page 6-18):

- watchdog = 0 ms (default)
  → outputs hold the momentary value
- watchdog > 0 ms
  → outputs switch to **0** after the watchdog time has expired (setting in register 0×1120).

NOTE

Setting the outputs to predefined substitute values is not possible in Modbus TCP. Eventually parameterized substitute values will not be used.

Behavior of the BUS LED

If the Watchdog has tripped, the BUS LED behaves as follows:

Watchdog	BUS LED
tripped	constantly red

6.4.12 Parameters and diagnostic messages of the I/O channels

NOTE

Please find explanations regarding parameters and diagnostic messages in the section Register mapping of the TBEN-L stations (page 6-21).

6.5 EtherNet/IP™

6.5.1 The EtherNet/IP™ Communications Profile

TECHNICAL BASICS

EtherNet/IP™ is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices. Communication between the nodes in the EtherNet/IP™ network can be carried out either via I/O Messages or Explicit Messages.

I/O Messages

I/O Messages serve to exchange high priority process and application data over the network. Communication between the slaves in the EtherNet/IP™ network is carried out according to the Server/Client Model,
which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit Messages

Explicit Messages are used to transmit low-priority configuration data, general management data or diagnostic data between two specific devices. This is a point-to-point connection in a Server/Client System that requires a request from a client always to be confirmed by a response from the server.

– Message Router Request
  Consists of a service code, path size value, a message router path and service data. An EPATH is used in the message router path to indicate the target object.
– Message Router Response
  Consists of a service field with the most significant bit set. This is an echo of the service code in the request message with the most significant bit set. A reserved byte follows the service code, which is followed by the General Status code.

Communication profile for TBEN-L

TBEN behaves as an EtherNet/IP™ server in the network; the scanner of the higher-level controller operates as a EtherNet/IP™ Client.

The following EtherNet/IP™ communications types are supported:

- Unicast
- Multicast
- Cyclic Connection
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

TECHNICAL BASICS

Unicast
A point-to-point connection that exists between two nodes only.

Multicast
A packet with a special destination address, which multiple nodes on the network may be willing to receive.

COS I/O Connection
COS (Change Of State) I/O Connections establish event-controlled connections. This means that the EtherNet/IP™ devices generate messages as soon as a change of status occurs.

Cyclic I/O Connection
Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

UCMM
The EtherNet/IP™ gateway offers the option of establishing explicit messaging via the UCMM port (Unconnected Message Manager Port).
UCMM-based explicit messaging is normally used for random, non-periodic requests.
It is not recommended for frequent messaging because the UCMM input queue in a product is typically limited to just a few messages. Once this limit is reached, subsequent requests are ignored and must be retried.

Connected Explicit Messaging
CIP is a connection-based system. For most communications between nodes, a connection is used.
A connection is a path or a virtual circuit between two or more end points in a system. The purpose is to transfer data in the most efficient manner possible.
The Connection ID is a number that is associated with a communication relationship. Receiving nodes decode this key to know whether they must accept the data or not.

6.5.2 EDS-file

The actual EDS-files for the modules can be downloaded from the TURCK-website www.turck.com.

Table 6-12: Designation of the EDS-files

Station	ZIP-file
TBEN-Lx-16DIP	TBEN-ETHERNET_IP.zip
TBEN-Lx-16DOP	
TBEN-Lx-8DIP-8DOP	
TBEN-Lx-16DXP	

6.5.3 Diagnostic messages via process data

Besides the evaluation of diagnostic data via Explicit Messages, TBEN-L with EtherNet/IP™ offers the possibility of mapping diagnostic data into the process data (see also the stations' process data mappings (page 6-43 ff.).

2 different forms of diagnostic data handling are provided:

- Summarized diagnostics
- Scheduled Diagnostics

Summarized Diagnostics

The summarized diagnostic data mode will send back the bit "I/O Diag" which indicates that one of the station channels send a diagnosis.

This bit will be "0" if there are no diagnostic flags set on the device. If there are any diagnostic events on the device, the bit will be set to "1".

Bit „I/O Diag“

0 = OK, no diagnostics present

1 = at least one channel sends diagnostics

Scheduled Diagnostics (manufacturer specific diagnosis)

In TBEN-stations, the scheduled diagnostics feature (Process Data Class (VSC102) (page 6-59)) is used for mapping the channel diagnostic bits into the process data (see also the modules' process data mappings (page 6-43 ff.).

Bit „SchedDiag“

0 = no mapping of I/O-channel diagnostics to process data

1 = mapping of I/O-channel diagnostics to the process input data active

6.5.4 QC - QuickConnect

TECHNICAL BASICS

QuickConnect enables a PLC to build up connections to EtherNet/IP™ nodes in less than 300 ms after switching-on the power supply for the EtherNet/IP™ network. This fast start up of devices is above all necessary for robotic tool changes for example in the automobile industry.

Ethernet cabling for TBEN in QC applications

NOTE

Please read Ethernet connection for QC-/FSU-applications (page 4-2) for information about the correct Ethernet-cabling in QC-applications with TBEN,

QuickConnect in TBEN-L

TURCK TBEN-L stations support QuickConnect.

QuickConnect is activated:

- via the configuration data in the PLC-program per Assembly Class 0x04, Configuration Assembly 106, bit 9 = 1

or

- via Class Instance Attribute in TCP/IP Interface Object (245×F5), instance 1, attribute 12

NOTE

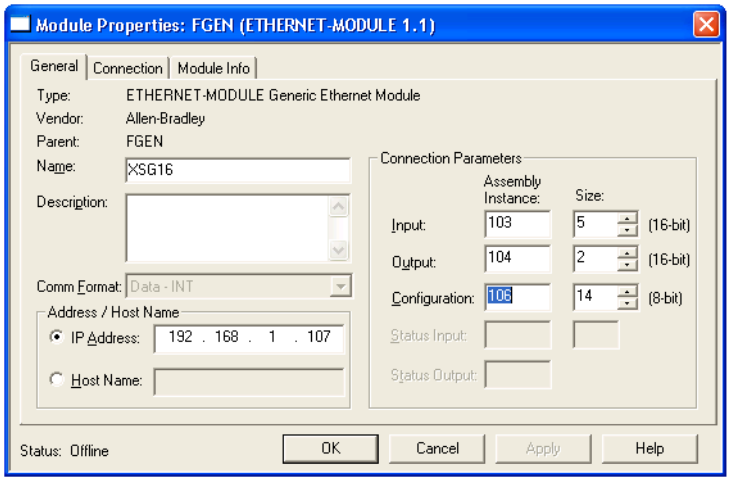
Activating QuickConnect also activated the automatic setting of all necessary port-properties:

Auto-negotiation	= deactivated
Transmission speed	= 100BaseT
Duplex	= Full duplex
Topology	= linear
AutoMDIX	= deactivated

QuickConnect via Configuration Assembly

The Configuration Assembly is part of the Assembly Class of the device and is defined during the station's configuration in the RS Logix-software by Rockwell Automation.

Figure 6-4: Configuration Assembly



Quick Connect via Class Instance Attribute

Activate QuickConnect via Class Instance Attribute using the following setting:

Class	Instance	Attributes	Value
245 (0xF5)	1 (0x01)	12 (0x0C)	0 = activated (default) **1= activated**

QuickConnect via web server

QuickConnect can also be activated or deactivated using the device's web server, see also chapter 8.9 The web server, Station Configuration (page 8-11).

6.5.5 Device Level Ring (DLR)

TECHNICAL BASICS

The Device Level Ring (DLR)-redundancy protocol is used to increase the stability of EtherNet/IP™ networks.
DLR-capable products provide an integrated switch and can thus be integrated into a ring topology.
The DLR-protocol is used to recognize a ring fault. In case of an interruption of the data line, data are sent through an alternative network section, so that the network can be reconfigured as soon as possible.
DLR-capable network nodes are provided with extended diagnostic functions which enable the devices to localize errors and thus decrease the time for error search and maintenance.

6.5.6 EtherNet/IP™ Standard Classes

The TBEN-L stations support the following EtherNet/IP™ Standard Classes in accordance with the CIP specification.

Table 6-13: EtherNet/IP™ Standard Classes

Class Code	Object name
01 (0x01)	Identity Object (0x01)
04 (0x04)	Assembly Object (0x04)
06 (0x06)	Connection Manager Object (0x06)
245 (0xF5)	TCP/IP Interface Object (0xF5)
246 (0xF6)	Ethernet Link Object (0xF6)

Identity Object (0x01)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to TBEN-L.

Class attributes

Table 6-14: Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
6 (0x06)	MAX CLASS ATTRIBUTE	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	7

Instance attributes

Table 6-15: Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	VENDOR	G	UINT	Contains the vendor ID. TURCK = 48
2 (0x02)	PRODUCT TYPE	G	UINT	Indicates the general type of product. Communications Adapter 12_{dec} = 0x0C
3 (0x03)	PRODUCT CODE	G	UINT	Identifies a particular product within a device type. Default: 27247_{dec} = 6A6F
4 (0x04)	REVISION Major Minor	G	STRUCT OF: USINT USINT	Revision of the item the Identity Object is representing. 0x01 0x06
5 (0x05)	DEVICE STATUS	G	WORD	See Table 6-16: Device Status
6 (0x06)	SERIAL NUMBER	G	UDINT	Contains the ident-no. of the product (3 last bytes of the MAC-ID).
7 (0x07)	PRODUCT NAME LENGTH NAME	G	STRUCT OF: USINT STRING [13]	e. g.: TBEN-L-16DXP

Device Status

Table 6-16: Device Status

Bit	Name	Definition
0 to 1	reserved	Default = 0
2	Configured	TRUE = 1 → The application of the device has been configured (≠ default-settings).
3	reserved	Default = 0
4 to 7	Extended Device Status	0011 = no I/O connection established 0110 = At least one I/O connection in run mode 0111 = At least one I/O connection established, all in IDLE mode All other settings = reserved
8 to 15	reserved	Default = 0

Common Services

Table 6-17: Common services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined list of the object's attributes.
05 (0x05)	no	yes	Reset Starts the reset service for the device.
14 (0x0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.
16 (0x10)	no	no	Set_Attribute_Single Modifies a single attribute.

Assembly Object (0x04)

Assembly Objects bind attributes of multiple objects to allow data to or from each object to be sent or received over a single connection.

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to TBEN-L.

Class attributes

Table 6-18: Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	2
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	104

Instance attributes

Table 6-19: Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
3 (0x03)	DATA	S	ARRAY OF BYTE	
4 (0x04)	SIZE	G	UINT	UINT Number of bytes in attr. 3 256 or variable

Common Services

Table 6-20: Common services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	no	yes	Get_Attribute_Single

Configuration Assembly

TBEN-L stations support Configuration Assembly. It enables an EDS-based configuration/parameterization of the devices in the PLC software (if supported by the PLC).

Instance 106

The Configuration Assembly contains:

10 byte configuration data

+ x byte parameter data of the respective device

Table 7: Size of the Configuration Assembly

Configuration Assembly			
Module	**Standard-bytes**	**Module dependent parameter data**	total
TBEN-Lx-16DIP	10 Byte	21 Byte	31
TBEN-Lx-16DOP	10 Byte	4 Byte	14
TBEN-Lx-8DIP-8DOP	10 Byte	16 Byte	26
TBEN-Lx-16DXP	10 Byte	26 Byte	36

- Configuration Assembly (TBEN-Lx-16DIP)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0 to 8	Reserved							
	9	-	-	-	-	-	-	-	QC
Parameter data of I/O-channels	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	10	Reserved							
	11								
	12	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	13	Inv. DI16	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9
	14	Reserved							
	15	Pulse stretching input 1							
	16	Pulse stretching input 2							
	17	Pulse stretching input 3							
	18	Pulse stretching input 4							
	19	Pulse stretching input 5							
	20	Pulse stretching input 6							
	21	Pulse stretching input 7							
	22	Pulse stretching input 8							
	23	Pulse stretching input 9							
	24	Pulse stretching input 10							
	25	Pulse stretching input 11							
	26	Pulse stretching input 12							
	27	Pulse stretching input 13							
	28	Pulse stretching input 14							
	29	Pulse stretching input 15							
	30	Pulse stretching input 16							

→ see parameter description for TBxx-Lx-16DIP (page 5-3).

- Configuration Assembly (TBEN-Lx-16DIP)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0 to 8	Reserved							
	9	-	-	-	-	-	-	-	QC
Parameter data of I/O-channels	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	10	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1
	11	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
	12	Reserved							
	13								
	14								
	15								

→ see parameter description for TBxx-Lx-16DOP (page 5-6).

- Configuration Assembly (TBEN-Lx-16DIP)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0 to 8	Reserved							
	9	-	-	-	-	-	-	-	QC
Parameter data of I/O-channels	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	10	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	11	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
	12	Reserved							
	13								
	14								
	15	Pulse stretching input 1							
	16	Pulse stretching input 2							
	17	Pulse stretching input 3							
	18	Pulse stretching input 4							
	19	Pulse stretching input 5							
	20	Pulse stretching input 6							
	21	Pulse stretching input 7							
	22	Pulse stretching input 8							

→ see parameter description for TBxx-Lx-8DIP-8DOP (page 5-8).

- Configuration Assembly (TBEN-Lx-16DXP)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0 to 8	Reserved							
	9	-	-	-	-	-	-	-	QC
Parameter data of I/O-channels	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	10	Reserved							
	11								
	12	Inv. DI8	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1
	13	Inv. DI6	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9
	14	SRO8	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1
	15	SRO16	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9
	16	EN DO8	EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1
	17	EN DO10	EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9
	18	Reserved							
	19	Pulse stretching input 1							
	20	Pulse stretching input 2							
	21	Pulse stretching input 3							
	22	Pulse stretching input 4							
	23	Pulse stretching input 5							
	24	Pulse stretching input 6							
	25	Pulse stretching input 7							
	26	Pulse stretching input 8							
	27	Pulse stretching input 9							
	28	Pulse stretching input 10							
	29	Pulse stretching input 11							
	30	Pulse stretching input 12							
	31	Pulse stretching input 13							
	32	Pulse stretching input 14							
	33	Pulse stretching input 15							
	34	Pulse stretching input 16							

→ see parameter description for TBxx-Lx-16DXP (page 5-11).

Process data instances

Instance 101

Contains the station's input data (static length 256 bytes).

2 Bytes status information (see page 6-8)

+ process data

Instance 102

Contains the station's output data (static length 256 bytes).

2 Bytes Control data (mapped, but not defined)

+ process data

Instance 103 and Instance 104

In- and output assembly instances with variable assembly sizes. The assembly size is pre-calculated to support the stations I/O-configuration, enabled diagnostics, etc.

- input assembly instance: 103
- output assembly instance: 104

The effective size of the Assembly Instance can be determined using the Assembly Object (instance 0×67, attribute 0x04) and can be from 2 to 496 bytes large.

Process data mapping TBEN-Lx-16DIP

- Scheduled diagnostic data mode
  default setting, see page 6-32

IN = 8 Byte
OUT = 2 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI1 C1P2	DI1 C1P4
	3	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
Diag-nostics	3	-	-	-	-	-	-	-	I/O Diag
	4	-	-	Sched Diag	-	-	-	-	-
	5	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	6	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of Process data bits (page 6-48)

- No diagnostic message,
  Status- and control-word can be deactivated, see page 6-10.

IN = 4 Byte
OUT = 2 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	-	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI1 C1P2	DI1 C1P4
	3	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of Process data bits (page 6-48)

Process data mapping TBEN-Lx-16DOP

- Scheduled diagnostic data mode
  default setting, see also page 6-32.

IN = 8 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Diag-nostics	2	-	-	-	-	-	-	-	I/O Diag
	3	-	-	Sched Diag	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
	5	SCO8	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1
	6	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
	7	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	3	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4

→ Meaning of Process data bits (page 6-48)

- No diagnostic message,
  Status- and control-word can be deactivated, see page 6-10.

IN = 2 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	3	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4

→ Meaning of Process data bits (page 6-48)

Process data mapping TBEN-Lx-8DIP-8DOP

- Scheduled diagnostic data mode
  default setting, see page 6-32

IN = 8 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	3	-	-	-	-	-	-	-	-
Diag-nostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	7	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
	3	-	-	-	-	-	-	-	-

→ Meaning of Process data bits (page 6-48)

- No diagnostic message,
  Status- and control-word can be deactivated, see page 6-10.

IN = 4 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	3	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4
	3	-	-	-	-	-	-	-	-

→ Meaning of Process data bits (page 6-48)

Process data mapping TBEN-Lx-16DXP

- Scheduled diagnostic data mode
  default setting, see page 6-32

IN = 10 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	3	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
Diag-nostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS8	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1
	7	SCO8	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1
	8	SCO16	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9
	9	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	3	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4

→ Meaning of Process data bits (page 6-48)

- No diagnostic message,
  Status- and control-word can be deactivated, see page 6-10.

IN = 4 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_2	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	V_1	-
Inputs	2	DI8 C4P2	DI7 C4P4	DI6 C3P2	DI5 C3P4	DI4 C2P2	DI3 C2P4	DI2 C1P2	DI1 C1P4
	3	DI16 C8P2	DI15 C8P4	DI14 C7P2	DI13 C7P4	DI12 C6P2	DI11 C6P4	DI10 C5P2	DI9 C5P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO8 C4P2	DO7 C4P4	DO6 C3P2	DO5 C3P4	DO4 C2P2	DO3 C2P4	DO2 C1P2	DO1 C1P4
	3	DO16 C8P2	DO15 C8P4	DO14 C7P2	DO13 C7P4	DO12 C6P2	DO11 C6P4	DO10 C5P2	DO9 C5P4

→ Meaning of Process data bits (page 6-48)

Meaning of Process data bits

Table 6-1: Meaning of Process data bits

Name	Meaning
I/O-data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = Pin
Diagnostics	
DiagWarn	see VSC 100, attr. 109 (6Dh), Status register 2 (page 6-58)
V_2	
V_1	
COM	
CFG	
FCE	
I/O Diag	Group diagnostics of in-/outputs
SchedDiag	The mapping of input and output diagnostics is activated
SCSx	Error at sensor supply of the respective connector
SCOx	Short-circuit at output

Connection Manager Object (0x06)

This object is used for connection and connectionless communications, including establishing connections across multiple subnets.

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to TBEN-L.

Common services

Table 6-2: Common services

Service code	Class	Instance	Service name
84 (0x54)	no	yes	FWD_OPEN_CMD (Opens a connection)
78 (0x4E)	no	yes	FWD_CLOSE_CMD (Closes a connection)
82 (0x52)	no	yes	UNCONNECTED_SEND_CMD

TCP/IP Interface Object (0xF5)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to TBEN-L.

Class attributes

Table 6-3: Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0x03)	NUMBER OF INSTANCES	G	UINT	1
6 (0x06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance attributes

Table 6-4: Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	STATUS	G	DWORD	Interface status (see page 6-51, Table 6-6: Interface Status)
2 (0x02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag (see page 6-51, Table 6-7: Configuration Capability)
3 (0x03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag (see page 6-52, Table 6-8: Configuration Control)
4 (0x04)	PHYSICAL LINK OBJECT	G	STRUCT	
	Path size		UINT	Number of 16 bit words: (0x02)
	path		Padded EPATH	0x20, 0xF6, 0x24, 0x01
5 (0x05)	INTERFACE CONFIGURATION	G	Structure of:	TCP/IP Network Interface Configuration (see page 6-52)
	IP address	G	UDINT	Current IP address
	NETWORK MASK	G	UDINT	Current network mask
	GATEWAY ADDR.	G	UDINT	Current default gateway
	NAME SERVER	G	UDINT	0 = no name server address configured
	NAME SERVER 2		UDINT	0 = no secondary name server address configured
	DOMAIN NAME	G	UDINT	0 = no Domain Name configured
6 (0x06)	HOST NAME	G	STRING	0 = no Host Name configured (see page 6-52)
12 (0x0C)	Quick Connect	G/S	BOOL	0 = deactivate 1 = activate

Common Services

Table 6-5: Common services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
02 (0x02)	no	no	Set_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
16 (0x10)	no	yes	Set_Attribute_Single

- **Interface Status**
  The Status attribute indicates the status of the TCP/IP network interface.
  Refer to the state diagram, Figure 6-5: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1) for a description of object states as they relate to the Status attribute.

Table 6-6: Interface Status

Bit(s)	Name	Definition
0-3	Interface Configuration Status	Indicates the status of the Interface Configuration attribute: 0 = The Interface Configuration attribute has not been configured 1 = The Interface Configuration attribute contains valid configuration. 2 to 15: reserved
4 to 31	reserved	

- **Configuration Capability**
  The Configuration Capability indicates the device's support for optional network configuration capability.

Table 6-7: Configuration Capability

Bit(s)	Name	Definition	Value
0	BOOTP Client	The device is capable of obtaining its network configuration via BOOTP.	1
1	DNS Client	The device is capable of resolving host names by querying a DNS server.	0
2	DHCP Client	The device is capable of obtaining its network configuration via DHCP.	1

- **Configuration Control**
  The Configuration Control attribute is used to control network configuration options.

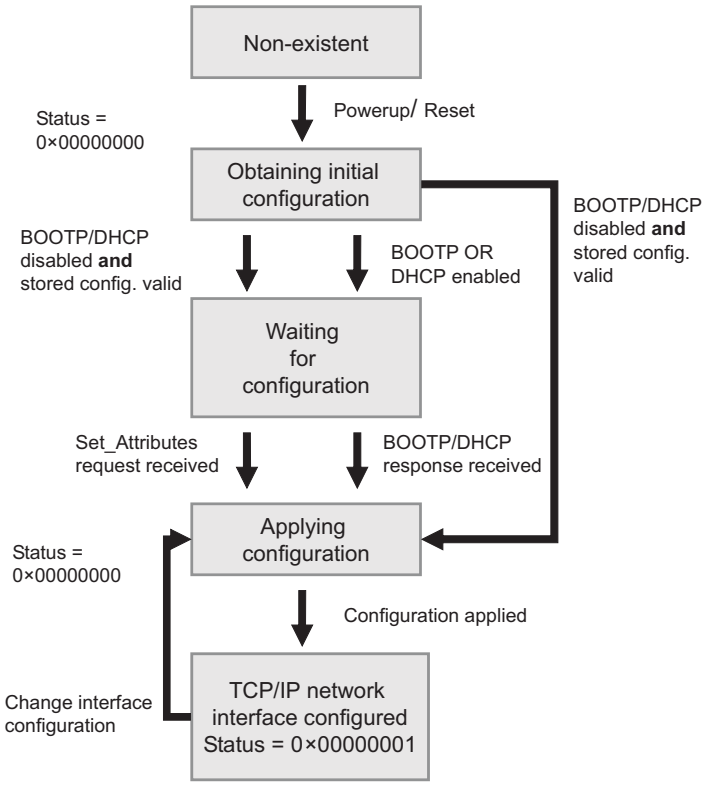
Table 6-8: Configuration Control

Bit(s)	Name	Definition
0-3	Startup Configuration	Determines how the device shall obtain its initial configuration at 0 = The device shall use the interface configuration values previously stored (for example, in non-volatile memory or via hardware switches, etc). 1 to 3: reserved
4	DNS Enable	Always 0.
5-31	reserved	Set to 0.

- **Interface Configuration**
  This attribute contains the configuration parameters required to operate as a TCP/IP node.
  To modify the Interface Configuration attribute, get the Interface Configuration attribute first, change the desired parameters, then set the attribute.
  The TCP/IP Interface Object applies the new configuration upon completion of the Set service. If the value of the Startup Configuration bits (Configuration Control attribute) is 0, the new configuration is stored in non-volatile memory.
  The device does not reply to the set service until the values are safely stored to non-volatile memory.
  An attempt to set any of the components of the Interface Configuration attribute to invalid values results in an error (status code 0x09) returned from the Set service.
  If initial configuration is obtained via BOOTP or DHCP, the Interface Configuration attribute components are all 0 until the BOOTP or DHCP reply is received.
  Upon receipt of the BOOTP or DHCP reply, the Interface Configuration attribute shows the configuration obtained via BOOTP/DHCP.

- **Host Name**
  The Host Name attribute contains the device's host name.
  The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up.
  The mechanism allows the DHCP client to transmit its host name to the DHCP server. The DHCP server then updates the DNS records on behalf of the client.

Figure 6-5: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)



Ethernet Link Object (0xF6)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to TBEN-L.

Class attributes

Table 6-9: Class Attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0x03)	NUMBER OF INSTANCES	G	UINT	1
6 (0x06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance attributes

Table 6-10: Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	INTERFACE SPEED	G	UDINT	Speed in megabits per second (e.g., 10, 100, 1000, etc.)
2 (0x02)	INTERFACE FLAGS	G	DWORD	see Table 6-11: Interface flags
3 (0x03)	PHYSICAL ADDRESS	G	ARRAY OF USINT	Contains the interface's MAC address (TURCK: 00:07:46:xx:xx:xx)
6 (0x06)	INTERFACE CONTROL		2 WORD	Allows port-wise changes of the Ethernet-settings
7 (0x07)	INTERFACE TYPE			
10 (0x0A)	INTERFACE LABEL			

Table 6-11: Interface flags

Bits	Name	Definition	Default value
0	Link Status	Indicates whether or not the Ethernet 802.3 communications interface is connected to an active network. 0 = inactive link 1 = active link.	Depends on application
1	Half/full duplex	0 = half duplex; 1 = full duplex If the Link Status flag is 0, the value of the Half/Full Duplex flag is indeterminate.	Depends on application
2 to 4	Negotiation Status	Indicates the status of the automatic duplex-negotiation (auto-negotiation) 0 = Auto-negotiation in progress 1 = Auto-negotiation and speed detection failed. Using default values for speed and duplex (10 Mbps/half duplex). 2 = Auto negotiation failed but detected speed (default: half duplex). Half duplex 3 = Successfully negotiated speed and duplex. 4 = Auto-negotiation not attempted. Forced speed and duplex.	Depends on application
5	Manual Setting Requires Reset	0 = interface can activate changes to link parameters (auto-negotiate, duplex mode, interface speed) automatically 1 = device requires a Reset service to be issued to its Identity Object in order to adapt the changes	0

Table 6-11: Interface flags	Bits	Name	Definition	Default value
	6	Local Hardware Fault	0 = interface detects no local hardware fault 1 = a local hardware fault is detected	0

Common Services

Table 6-12: Common services	Service code	Class	Instance	Service name
	01 (0x01)	yes	yes	Get_Attribute_All
	14 (0x0E)	yes	yes	Get_Attribute_Single
	76 (0x4C)	no	yes	Enetlink_Get_and_Clear

6.5.7 VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the TBEN-L stations support the vendor specific classes described in the following.

Table 6-13: VSC-Vendor Specific Classes	Class Code dec. (hex.)	Name	Description
	100 (64h)	Gateway Class, page 6-57	Contains data and settings concerning the field bus-specific part of the TBEN-L stations.
	102 (66h)	Process Data Class, page 6-59	Contains process data
	117 (75h)	Digital Versatile Module Class, page 6-60	Describes the I/O-channels
	126 (1Ah)	Miscellaneous Parameters Class, page 6-62	Describes the EtherNet/IP™-Port properties

Class instance of the VSC

NOTE

The class instance attributes are the same for each Vendor Specific Class.

The class-specific Object Instances and the corresponding attributes are explained in the paragraphs for the different VSC.

The general VSC - class instance attributes are defined as follows:.

Table 6-14: Class instance

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	Class revision	G	UINT	States the revision number of the class (Maj. Rel. *1000 + Min. Rel.).
101 (65h)	Max. instance	G	USINT	Contains the number of the highest instance of an object created on this level in the class hierarchy.
102 (66h)	# of instances	G	USINT	Contains the number of Object Instances created in this class.
103 (67h)	MAX CLASS ATTRIBUTE	G	USINT	Contains the number of the last Class Attribute to be implemented.

Gateway Class (VSC 100)

This class contains all information which refers to the whole station not to the different I/O channels.

Class instance

NOTE

Please refer to paragraph Class instance of the VSC (page 6-55) for the description of the class instance for the VSC.

Object Instance 1

Table 6-15: Object instance 1, Boot instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	MAX INSTANCE ATTRIBUTE	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	Hardware revision	G	STRUCT	Contains the hardware revision number of the station (USINT Maj./USINT Min.)
102 (66h)	Firmware revision	G	STRUCT	Contains the revision number of the Boot Firmware (Maj./Min.).
103 (67h)	Service tool ident number	G	UDINT	Contains the BOOT ID number that serves as an identification number for the software I/O-ASSISTANT
104 (68h)	Hardware info	G	STRUCT	Contains station hardware information (UINT): – count (number of the following entries) – CLOCK FREQUENCY (kHz) – MAIN FLASH (in kB) – MAIN FLASH SPEED (ns) – SECOND FLASH (kB) – RAM (kB), – RAM SPEED (ns), – RAM data WIDTH (bit), – SERIAL EEPRPOM (kbit) – RTC SUPPORT (in #) – AUTO SERVICE BSL SUPPORT (BOOL) – HDW SYSTEM

Object Instance 2

Table 6-16: Object Instance 2, Gateway Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (6Dh)	Status register 2	G	STRUCT	The Status Word contains general station status information: **station** – Bit 15: reserved – Bit 14: "Force Mode Active Error" The Force Mode is activated (FCE). – Bit 13: reserved – Bit 12: reserved **Internal bus** – Bit 11: "I/O Cfg Modified Error" (CFG) The configuration has been changed in an incompatible way. – Bit 10: "I/O Communication Lost Error" (COM) Communication on the internal module bus disturbed. **Voltage errors** – Bit 09: "V1 too low" V1 < 18 V DC – Bit 08: reserved – Bit 07: "V2 too low" V2 < 18 V DC – Bit 06: reserved – Bit 05: reserved – Bit 04: reserved **Warnings** – Bit 03: reserved – Bit 02: reserved – Bit 01: reserved – Bit 00: "I/O Diags Active Warning" (DiagnWarn) At least one I/O-channel sends active diagnostics.
115 (73h)	ON IO CONNECTION TIMEOUT	G/S	ENUM USINT	Reaction to the I/O connection exceeding the time limit. SWITCH IO FAULTED (0): The modules are switched to Faulted State. SWITCH IO OFF (1): The gateway switches off the outputs of the modules. SWITCH IO HOLD (2): No further changes to the I/O-data. The outputs are held.
138 (0x8A)	GW Status Register	Get/ Set	DWORD	Allows to enable/disable the status register which is part of the input data.
139 (0x8B)	GW Control Register	Get/ Set	DWORD	Allows to enable/disable the control register which is part of the output data.

Table 6-16: Object Instance 2, Gateway Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
140 (0x8C)	Disable Protocols	Get/ Set	UINT	Deactivation of the used Ethernet protocol. bit assignment 0 = EtherNet/IP (can not be disabled via EtherNet/IP™-interface) 1 = Modbus/TCP 2 = PROFINET 3 to 14: reserved 15 = web server

Process Data Class (VSC102)

This class contains the process-relevant information.

Class instance

NOTE

Please refer to paragraph Class instance of the VSC, page 6-55, for the description of the class instances for VSC.

Object instance 1, standard input process data (compressed)

This instance is not supported.

Object instance 2, standard output process data (compressed)

This instance is not supported.

Object Instance 3, diagnostic instance

Table 6-17: Object Instance 3, diagnostic instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
104 (68h)	GW Summarized diagnostics	G/S	BOOL	0 = disabled 1 = enabled: 1 bit of diagnosis mapped at the end of the input data image (page 6-32). Changes become valid after a start-up!
105 (69h)	GW manufacturer specific diagnostics (scheduled diagnostics)	G/S	BOOL	0 = disabled 1 = activated: used for activating the mapping of the channel-specific diagnostic bits to the process input data page 6-32. Changes become valid after a start-up!
106 (6Ah)	reserved			-

Object Instance 4, COS/CYCLIC instance

Table 6-18: Object Instance 4, COS/CYCLIC instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
104 (68h)	COS data mapping	G/S	ENUM USINT	The actual data are loaded to the non-volatile memory of the station. Changes become valid after a start-up! 0 = standard: Data of COS message → input data. 1 = process input data (only the process data input image is transferred to scanner) 2 to 7: reserved

Digital Versatile Module Class (VSC117)

This class contains all information and parameters for the station's digital I/O channels.

Object Instance

Table 6-19: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	reserved			-
102 (66h)	reserved			-
103 (67h)	Module ID	G	DWORD	Contains the station-ID.
104 (68h)	Module order number	G	UDINT	Contains the ident number of the station.
105 (69h)	Module order name	G	SHORT STRING	Contains the name of the station.
106 (6Ah)	Module revision	G	USINT	Contains the revision number of the station.
107 (6Bh)	Module type ID	G	ENUM USINT	Describes the station type: 0x01: digital station
108 (6Ch)	Module command interface	G/S	ARRAY	The station's command interface. ARRAY OF: BYTE: Control byte sequence
109 (6Dh)	Module response interface	G	ARRAY	The station's response interface. ARRAY OF: BYTE: Response byte sequence
110 (6Eh)	Module registered index	G	ENUM USINT	Contains the index numbers specified in all the station lists.

Table 6-19: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
111 (6Fh)	Module input channel count	G	USINT	Contains the number of input channels supported by the station.
112 (70h)	Module output channel count	G	USINT	Contains the number of output channels supported by the station.
Input data				
113 (71h)	Module input_1	G	DWORD	Input data of the respective I/Os.
114 (73h)	Module input_2	G	DWORD	Input data of the respective I/Os.
Output data				
115 (73h)	Module output_1	G	DWORD	Output put data of the respective I/Os.
116 (75h)	Module output_2	G	DWORD	Output put data of the respective I/Os.
...				
Diagnostics				
119 (77h)	Short circuit output error_1	G	DWORD	Short-circuit at output
120 (78h)	Short circuit output error_2	G	DWORD	Short-circuit at output
121 (79h)	Short circuit V_{AUX} error_1	G	DWORD	Overcurrent at sensor/actuator supply
122 (80h)	Short circuit V_{AUX} error_2	G	DWORD	Overcurrent at sensor/actuator supply
...				
Parameter data				
127 (7Fh)	Invert input data_1	G/S	DWORD	The input signal is inverted (channel 1 to 16).
...				
133 (85h)	Auto recovery output_1	G/S	DWORD	The outputs switch on automatically after an overload (output 1 to 16).
...				
137 (89h)	Retriggered recovery output_1	G/S	DWORD	The outputs (channel 1 to 16) have to be re-triggered in case of an overload.
...				
139 (8Bh)	Enable high side output driver_1	G/S	DWORD	Enables the high side output driver of channels (channel 1 to 16).

Table 6-19: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
...				
149 (95h) to 164 (a4h)	Pulse stretching input x	G/S	Byte	The input signal is stretched to a time between 0 to 2550 ms in steps of 10 ms. Default setting: 0 0 = pulse stretching deactivated (standard pulse 2,5 ms) Example: 10 = pulse of 100 ms

Miscellaneous Parameters Class (VSC 126)

Instance 1/Instance 2

Table 6-20: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (6Dh)	Ethernet port parameters	G/S	DWORD	0 = Autonegotiate, AutoMDIX **A** 1 = 100BaseT, half duplex, linear topology (AutoMDIX disabled) 2 = 10BaseT, full duplex, linear topology (AutoMDIX disabled) 3 = 100BaseT, half duplex, linear topology (AutoMDIX disabled) 4 = 100BaseT, full duplex, linear topology (AutoMDIX disabled)
112 (70h)	IO Controller Software revision	G	DWORD	The number of instances of this parameter depends on the number of I/O controllers.

6.6 PROFINET

TECHNICAL BASICS

PROFINET is the innovative open standard for the implementation of end-to-end integrated automation solutions based on Industrial Ethernet. With PROFINET, simple distributed I/O and time-critical applications can be integrated into Ethernet communication just as well as distributed automation system on an automation component basis.

Distributed I/O with PROFINET IO

Distributed I/O is connected into communication through PROFINET IO. Here, the familiar I/O view of PROFIBUS is retained, in which the peripheral data from the field devices are periodically transmitted into the process model of the control system.

Device Model

PROFINET IO describes a device model oriented to the PROFIBUS framework, consisting of places of insertion (slots) and groups of I/O channels (sub slots). The technical characteristics of the field devices are described by the so-called GSD (General Station Description) on an XML basis.

Field bus integration

PROFINET offers a model for integration of existing field buses like PROFIBUS, AS-Interface, and INTERBUS.
This allows the construction of arbitrarily mixed systems consisting of fieldbus- and Ethernet-based segments. Thus a smooth technology transition is possible from fieldbus-based systems to PROFINET. The large number of fieldbus systems makes it necessary to support their simple integration into PROFINET for reasons of investment protection.
The integration is done with so-called "proxies". A proxy is a device which connects an underlying fieldbus with PROFINET. The proxy concept allows the device manufacturer, the plant and machine builder as well as the end user a high degree of investment protection.

Communications in PROFINET

Communications in PROFINET contain different levels of performance:
The non-time-critical transmission of parameters, configuration data, and switching information occurs in PROFINET in the standard channel based on UDP and IP. This establishes the basis for the connection of the automation level with other networks (MES, ERP).
For the transmission of time critical process data within the production facility, there is a Real-Time channel (RT) available.
For particularly challenging tasks, the hardware based communication channel Isochronous Real-Time (IRT) can be used for example in case of Motion Control Applications and high performance applications in factory automation.

UDP/IP communication

For non-time-critical processes, PROFINET uses communications with the standard Ethernet mechanisms over UDP/IP which follow the international standard IEEE 802.3.
Similar to standard Ethernet, PROFINET field devices are addressed using a MAC and an IP address. In UDP/IP communications, different networks are recognized based on the IP address. Within a network, the MAC address is a unique criterion for the addressing of the target device. PROFINET field devices can be connected to the IT world without limitations. A prerequisite for this is that the corresponding services, for instance file transfer, must be implemented in the field device involved. This can differ from manufacturer to manufacturer.

Real-time communication (RT)

A data communication over the UDP/IP channel is provided with a certain amount of administrative and control information for addressing and flow control, all of which slows data traffic.
To enable Real-Time capability for cyclical data exchange, PROFINET abandons partially IP addressing and flow control over UDP for RT communications. The communication mechanisms of the Ethernet (Layer 2 of the ISO/OSI model) are very suitable for this. RT communications can always run in parallel with NRT communications.

The services of PROFINET IO

– Cyclic data exchange
  For the cyclic exchange of process signals and high-priority alarms, PROFINET IO uses the RT channel.
– Acyclic data exchange (record data)
  The reading and writing of information (read/write services) can be performed acyclically by the user. The following services run acyclically in PROFINET IO:
  – parameterization of individual submodules during system boot
  – reading of diagnostic information
  – reading of identification information according to the "Identification and Maintenance (I&M) functions"
  – reading of I/O data

Address assignment

In IP-based communications, all field devices are addressed by an IP address.
PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.
In the delivery state each device amongst others has a MAC address. This information is enough to assign each field device a unique name (appropriate to the installation).
Address assignment is performed in two steps:
– Assignment of a unique plant specific name to the field device.
– Assignment of the IP address by the IO-Controller before system boot based on the plant specific (unique) name.

6.6.1 Install GSD files

The actual GSDML-file for TBEN can be downloaded from the TURCK-website www.turck.com.

Table 6-21: Designation of the GSDML-files

Module	ZIP-file
TBEN-Lx-16DIP	TBEN-PROFINET.zip
TBEN-Lx-16DOP	
TBEN-Lx-8DIP-8DOP	
TBEN-Lx-16DXP	

6.6.2 FSU - Fast Start-Up (prioritized startup)

TECHNICAL BASICS

FSU enables a PLC to build up connections to PROFINET-nodes in less than 500 ms after switching-on the network power supply. This fast start up of devices is above all necessary for robotic tool changes for example in the automobile industry.

Ethernet cabling for TBEN-L in QC applications

NOTE

Please read Ethernet connection for QC-/FSU-applications (page 4-2) for information about the correct Ethernet-cabling in QC-applications with TBEN,

FSU in TBEN-L

TURCK TBEN-L stations support the prioritized start-up (FSU).

In order to enable FSU, the field bus nodes have to be configured respectively in HW Config in the Step 7-software (Siemens).

- Autonegotiation: disable
- Transmission medium/duplex: set to a fixed value

Please observe, during configuration, that the settings for the ports of neighboring devices are identical.

Figure 6-6: HW Config - Prioritized stat-up - activation at PN-IO

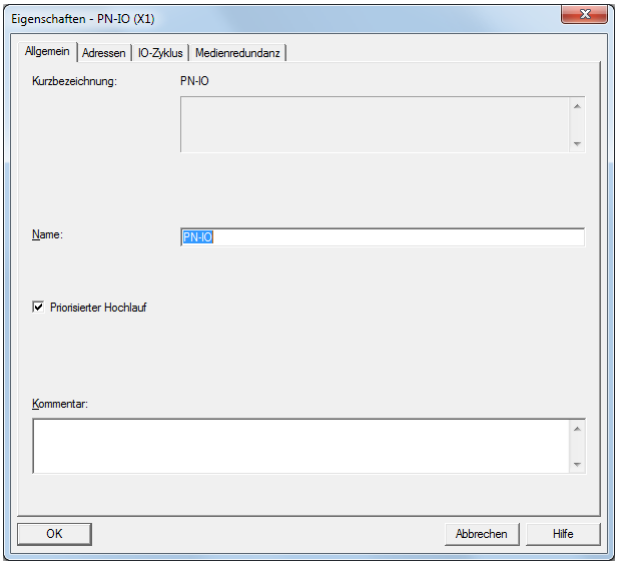
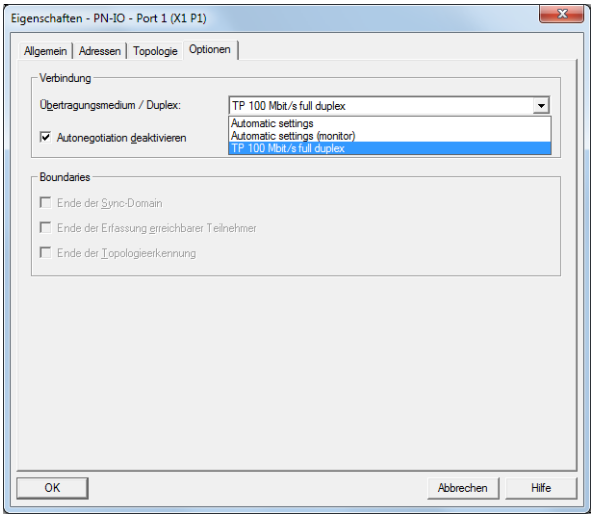


Figure 6-7: HW Config - Port setting (at one example port)



6.6.3 MRP (Media Redundancy Protocol)

TECHNICAL BASICS

MRP is a standardized protocol according to IEC 62439.
It describes a mechanism for media redundancy in ring topologies.
A Media Redundancy Manager (MRM) checks the ring topology of a PROFINET network defined by the network configuration for functionality. All other network nodes are Media Redundancy Clients (MRC).

NOTE

Detailed information about MRP in PROFINET can be found on the website of the PROFIBUS user organization under www.profibus.com.

6.6.4 PROFINET-diagnostics

TBEN-Lx-16DIP – diagnostic data mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error Code**	**Channel**
undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error Code**	**Channel**
Overload supply at connector (SCSx)			*Overcurrent VAUX*	
SCS1	E1.1	C1	0x001A	0
	E1.2			
SCS2	E1.3	C2	0x001A	1
	E1.4			
SCS3	E1.5	C3	0x001A	2
	E1.6			
SCS4	E1.7	C4	0x001A	3
	E1.8			
SCS5	E1.9	C5	0x001A	4
	E1.10			
SCS6	E1.11	C6	0x001A	5
	E1.12			
SCS7	E1.13	C7	0x001A	6
	E1.14			
SCS8	E1.15	C8	0x001A	7
	E1.16			

A *Slot according to configuration tool (e. g. Siemens HW Config)*

TBEN-Lx-16DOP – diagnostic data mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error Code**	**Channel**
undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error Code**	**Channel**
Overload supply at connector (SCSx)			*Overcurrent VAUX*	
SCS1	E1.1	C1	0x001A	0
	E1.2			
SCS2	E1.3	C2	0x001A	1
	E1.4			
SCS3	E1.5	C3	0x001A	2
	E1.6			
SCS4	E1.7	C4	0x001A	3
	E1.8			
SCS5	E1.9	C5	0x001A	4
	E1.10			
SCS6	E1.11	C6	0x001A	5
	E1.12			
SCS7	E1.13	C7	0x001A	6
	E1.14			
SCS8	E1.15	C8	0x001A	7
	E1.16			
Overcurrent at output (SCOx)			*overcurrent*	
SCO1	A1.1	C1P4	0x0001	0
SCO2	A1.2	C1P2	0x0001	1
SCO3	A1.3	C2P4	0x0001	2
SCO4	A1.4	C2P2	0x0001	3
SCO5	A1.5	C3P4	0x0001	4
SCO6	A1.6	C3P2	0x0001	5
SCO7	A1.7	C4P4	0x0001	6
SCO8	A1.8	C4P2	0x0001	7
SCO9	A1.9	C5P4	0x0001	8
SCO10	A1.10	C5P2	0x0001	9
SCO11	A1.11	C6P4	0x0001	10
SCO12	A1.12	C6P2	0x0001	11
SCO13	A1.13	C7P4	0x0001	12
SCO14	A1.14	C7P2	0x0001	13
SCO15	A1.15	C8P4	0x0001	14
SCO16	A1.16	C8P2	0x0001	15

A *Slot according to configuration tool (e. g. Siemens HW Config)*

TBEN-Lx-8DIP-8DOP – diagnostic data mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error Code**	**Channel**
undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error Code**	**Channel**
Overload supply at connector (SCSx)			*Overcurrent VAUX*	
SCS1	E1.1	C1	0x001A	0
	E1.2			
SCS2	E1.3	C2	0x001A	1
	E1.4			
SCS3	E1.5	C3	0x001A	2
	E1.6			
SCS4	E1.7	C4	0x001A	3
	E1.8			
SCS5	E1.9	C5	0x001A	4
	E1.10			
SCS6	E1.11	C6	0x001A	5
	E1.12			
SCS7	E1.13	C7	0x001A	6
	E1.14			
SCS8	E1.15	C8	0x001A	7
	E1.16			
Overcurrent at output (SCOx)			*overcurrent*	
SCO9	A1.1	C5P4	0x0001	0
SCO10	A1.2	C5P2	0x0001	1
SCO11	A1.3	C6P4	0x0001	2
SCO12	A1.4	C6P2	0x0001	3
SCO13	A1.5	C7P4	0x0001	4
SCO14	A1.6	C7P2	0x0001	5
SCO15	A1.7	C8P4	0x0001	6
SCO16	A1.8	C8P2	0x0001	7

A *Slot according to configuration tool (e. g. Siemens HW Config)*

TBEN-Lx-16DXP – diagnostic data mapping

Station diagnostics (slot 0 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**		**Error Code**	**Channel**
undervoltage				
V1	0.0	-	0x0002	0
V2	0.1	-	0x0002	1

I/O-diagnostics (slot 1 **A**)			**PROFINET diagnostics**	
Diagnostics	**Channel**	**Connector/ pin**	**Error Code**	**Channel**
Overload supply at connector (SCSx)			*Overcurrent VAUX*	
SCS1	A1.1	C1	0x001A	0
	A1.2			
SCS2	A1.3	C2	0x001A	1
	A1.4			
SCS3	A1.5	C3	0x001A	2
	A1.6			
SCS4	A1.7	C4	0x001A	3
	A1.8			
SCS5	A1.9	C5	0x001A	4
	A1.10			
SCS6	A1.11	C6	0x001A	5
	A1.12			
SCS7	A1.13	C7	0x001A	6
	A1.14			
SCS8	A1.15	C8	0x001A	7
	A1.16			
Overcurrent at output (SCOx)			*overcurrent*	
SCO1	A1.1	C1P4	0x0001	0
SCO2	A1.2	C1P2	0x0001	1
SCO3	A1.3	C2P4	0x0001	2
SCO4	A1.4	C2P2	0x0001	3
SCO5	A1.5	C3P4	0x0001	4
SCO6	A1.6	C3P2	0x0001	5
SCO7	A1.7	C4P4	0x0001	6
SCO8	A1.8	C4P2	0x0001	7
SCO9	A1.9	C5P4	0x0001	8
SCO10	A1.10	C5P2	0x0001	9
SCO11	A1.11	C6P4	0x0001	10
SCO12	A1.12	C6P2	0x0001	11
SCO13	A1.13	C7P4	0x0001	12
SCO14	A1.14	C7P2	0x0001	13
SCO15	A1.15	C8P4	0x0001	14
SCO16	A1.16	C8P2	0x0001	15

A *Slot according to configuration tool (e. g. Siemens HW Config)*

6.6.5 Parameters

Two types of parameters have to be distinguished for the TBEN-L stations, the PROFINET parameters of a station and the specific parameters of the I/O-channels.

General station parameters (turck-tben)

Table 6-22: Parameters for measurement mode

A *default setting*

Parameter name	Value	Meaning
Output behavior at communication loss	00 = set to 0 **A**	The station switches the outputs to "0". No error information is transmitted.
	10 = keep last value	The station maintains the actual output data.
Disable all diagnosis deactivate web server	0 = no **A**	Diagnostic messages and alarms are generated.
	1 = yes	Diagnostic messages and alarms are generated.
Deactivate load voltage diagnostics Deactivate all diagnostics	0 = no **A**	Monitoring of voltage V2 is activated.
	1 = yes	An under voltage at V2 is not monitored.
Deactivate I/O-ASSISTANT Force Mode	0 = no **A**	The single field bus protocols can be deactivated.
	1 = yes	
Deactivate EtherNet/IP™	0 = no **A**	
	1 = yes	
Deactivate Modbus TCP	0 = no **A**	
	1 = yes	
Deactivate WEB Server	0 = no **A**	
	1 = yes	

Parameters for I/O channels

Table 6-23: Parameters for I/O channels

Parameter name	Value	Meaning
Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	The input signal is inverted.
Manual output reset after overcurrent (SROx)	0 = no **A**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off and on again.
Activate output (EN DOx)	0 = no	
	1 = yes **A**	
Pulse stretching input (*10 ms)	0 - 255	The input signal is stretched to a time between 0 to 2550 ms in steps of 10 ms. Default setting: 0 0 = pulse stretching deactivated (standard pulse 2,5 ms) Example: 10 = pulse of 100 ms

A *default setting*

6.6.6 Description of user data for acyclic services

The acyclic data exchange is done via Record Data CRs (CR-> Communication Relation).

Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data
- Writing of configuration data
- Reading and writing of device data
- Reading of diagnostic data
- Reading of I/O data
- Reading of Identification Data Objects (I&M functions)

Description of the acyclic gateway user data

Table 6-24: Module Application Instance

Index (dec.)	Name	Data Type	r/w	Comment
1	Station parameters	WORD	r/w	Parameter data of the station (slot 0).
2	Station designation	STRING	r	Designation of the station (slot 0).
3	Station revision	STRING	r	Firmware revision of the station
4	Vendor-ID	WORD	r	Ident number for TURCK
5	Station name	STRING	r	The device name assigned to the station.
6	Station type	STRING	r	Device type of the station
7	Device-ID	WORD	r	Ident number of the station
8 to 23	reserved			
24	Station diagnosis	WORD	r	Diagnostic data of the station (slot 0).
25 to 31	reserved			
32	Input list	Array of BYTE	r	List of all input channels in the station
33	Output list	Array of BYTE	r	List of all output channels in the station
34	Diag. list	Array of BYTE	r	List of all I/O-channel diagnostics
35 (0x23)	Parameter list	Array of BYTE	r	List of all I/O-channel parameters
36 to 45039	reserved			
45040 (0xAFF0)	I&M0-functions		r	Identification & Maintaining-services
45041 (0xAFF1)	I&M1-functions	STRING [54]	r/w	I&M tag function and location
45042 (0xAFF2)	I&M2-functions	STRING [16]	r/w	I&M tag function and location
45043 (0xAFF3)	I&M3-functions	STRING [54]		
45044 (0xAFF4)	I&M4-functions	STRING [54]		
45045 (0xAFF5) to 45055 (0xAFFF)	I&M5 to I&M15-functions			not supported

Table 6-24: Module Application Instance

Index (dec.)	Name	Data Type	r/w	Comment
0x7000	Station parameters	WORD	r/w	Activate active field bus protocol

6.6.7 Description of the acyclic I/O-channel user data

Table 6-25: I/O channel user data

Index (dec.)	Name	Data type	r/w	Comment
1	Station parameters	specific	r/w	Parameters the station
2	Station type	ENUM UINT8	r	Contains the station type
3	Station version	UINT8	r	Firmware version of I/O-channels
4	Station-ID	DWORD	r	indent no. of I/Os
5 to 9	reserved			
10	Slave Controller Version	UINT8 array [8]	r	Versions number of the slave controllers.
11 to 18	reserved			
19	Input data	specific	r	Input data of the respective I/O channel
20 to 22	reserved			
23	Output data	specific	r/w	Output data of the respective I/O-channel

7 Module family TBDP-L

7.1 Configuration

7.1.1 General

This chapter describes all information concerning the configuration of TBDP-L-stations at PROFIBUS-DP.

7.1.2 GSD files

The actual GSD files can be downloaded from the TURCK-website www.turck.com.

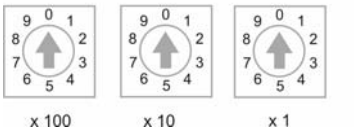
Table 7-1: Designation of the GSDML-files

Module	ZIP-file
TBDP-L2-16DIP	TBDP-PROFBUS.zip
TBDP-L2-16DOP	
TBDP-L2-8DIP-8DOP	
TBDP-L2-16DXP	

7.1.3 Address setting

The PROFIBUS-DP-address (1 to 126) is set using three decimal rotary coding switches placed under the transparent protective cover.

Figure 7-1: Address switches at the gateway



ATTENTION!

Close protective cover after address setting
Protection class IP65/IP67/IP69K not warranted

- ➤ Screw the protective cover over the rotary coding-switches firmly
- ➤ Check if seal of the protective cover is correctly placed

7.1.4 Transmission rates

The modules support transmission rates up to 12 Mbit/s.

They provide an autobaud function and set the baud rate automatically to the baud rate defined by the master.

7.1.5 Bus termination

The bus termination is realized via an external terminating resistor at fieldbus connector P2 (Bus-OUT).

The 5 V for the terminating resistor are provided by pin 1 (see also Connection to PROFIBUS (page 4-3))

7.2 Module status

7.2.1 LED-displays

Table 7-2: LED-displays of TBDP-L stations

A *can also occur in combination*

LED	Color	Status	Meaning	Remedy
Power				
TBDP-L2-16DIP	green	on	V1 ok	Check V1
		off	V1 < 18 V DC	
TBDP-L2-16DOP TBDP-L2-8DIP-8DOP TBDP-L2-16DXP	green	on	V1 and V2 OK	Check V1
		off	V1 missing or < 18 V DC	-
	red	on	V2 missing or < 18 V DC	Check V2
BUS	green	on	Device is ready for operation, PROFIBUS-connection OK	Check V1
		off	No voltage supply at device	
	red	on	PROFIBUS-connection disturbed No process data exchange	– Check the PROFIBUS-cabling – Check the PROFIBUS-configuration (DP-address, configuration in the master, etc.)
ERR	green	on	No diagnostic message available	
	red	on	Diagnostic message pending	
1 to 16				
TBDP-Lx-16DIP	green	flashing **A**	Input active, 24 V at input	
	red	flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Input inactive	

Table 7-2: LED-displays of TBDP-L stations

A *can also occur in combination*

LED	Color	Status	Meaning	Remedy
TBDP-L2-16DOP	green	flashing **A**	Output active	
	red	on	Output active, overload/overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output inactive	
TBDP-L2-16DXP	green	flashing **A**	Output or input active	
	red	on	output active, overload/ overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output or input active	
1 to 8				
TBDP-L2-8DIP-8DOP	green	flashing **A**	Input active, 24 V at input	
	red	flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off		
9 to 16		off	Output inactive	
TBDP-L2-8DIP-8DOP	green	flashing **A**	Output active	
	red	on	Output active, overload/overcurrent at output	
		flashing **A**	Overload of the supply voltage at the respective connector Both LEDs at the connector are flashing	Check the sensor supply
		off	Output inactive	

7.3 Diagnostics

The diagnostic telegram is structured as follows:

- 6 byte for the PROFIBUS-DP-diagnostics acc. to DP-standard (byte 0 to byte 5)
- 2 byte for the **device specific diagnostics** (module status),
  see below Module-status (device specific diagnostics) (page 7-5)
- 3 byte per diagnostic message for the **channel related** diagnostics
  (1 byte Header/slot + 1 byte channel + 1 byte diagnostics)

7.3.1 Module-status (device specific diagnostics)

Module Status	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Header)	Diag. Length							
Byte 1 (station diagnostics)	X	X	X	X	X	V2	V1	SCSx

X = reserved

Table 7-3: Bits of the device specific diagnostics

Bit	Meaning
Diag. Length	Length of the device specific diagnostics For TBDP-L: 0×02 (1 byte Header + 1 byte station diagnostics).
V1	V1 not within the permissible range (18 … 30 V DC)
V2	V2 not within the permissible range (18 … 30 V DC)
SCSx	group diagnostics: Error in the sensor supply of a channel The channel specific diagnostics contain a detailed definition of the faulty channel, see Channel specific diagnostics (page 7-5).

7.3.2 Channel specific diagnostics

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Header)	diag.-type		slot-no.					
Byte 1 (channel)	channel-type		channel-no.					
Byte 2 (diagnostics)	module type			diagnostic message				

Table 7-4: Bits of the channel specific diagnostics

Bit	Value	Meaning
Diag.-type	10	channel specific diagnostics
slot-no.	Defines, which channel sends a diagnostic message.	
	000001	Slot 1 (always overcurrent diagnostics)
	000010	Slot 2 (always sensor supply diagnostics)
channel-type	Bit 6 and 7 define, if the channel is an input or output channel.	
	01	input
	10	output
	11	in- and output
channel-no.	Bit 0 to bit 5 contain the "channel number". The channel number is - depending on the respective diagnostic message - defined as follows: – **Overcurrent diagnostics (SCOx):** Channel 0 to 15 = output 1 to 16 at module (LED 1 to 16) – **Overload sensor supply (SCSx):** Channel 0 to 15 = connector C1 to C16 at module → see Examples for the channel related diagnostics (page 7-7)	
Module type	Bit 5 to bit 7 define, if the module is a bit-, byte- or word-oriented module.	
	001	bit-oriented
	010	2 bit-oriented
	011	4 bit-oriented
	110	word-oriented
	111	double-word oriented
Diagnostic message	Bit 0 to 4 contain a value which specifies the diagnostic message:	
	0×01 (01 dec.)	SCOx (overcurrent at output x)
	0×1A (26 dec.)	SCSx (overload supply connector x) This diagnostic message is always related to both in- and outputs of the connector (C1 - C8).

Examples for the channel related diagnostics

1 TBDP-L2-16DOP:
Error in the sensor supply (SCSx) at connector C4 (outputs 7 + 8):

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Header)	**1**	0	0	0	0	0	**1**	0
	channel rel. diag.		Slot 2 (= sensor supply diagnostics)					
Byte 1 (channel)	**1**	**1**	0	0	0	**1**	**1**	0
	In-/output		channel 3 (= connector C4)					
Byte 2 (diagnostics)	0	0	**1**	**1**	**1**	0	**1**	0
	bit-oriented		SCSx (0×1A)					

2 TBDP-L2-8DIP-8DOP:
Error in the sensor supply (SCSx) at connector C6 (outputs 11 + 12):

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Header)	**1**	0	0	0	0	0	**1**	0
	channel rel. diag.		Slot 2 (= sensor supply diagnostics)					
Byte 1 (channel)	**1**	**1**	0	0	**1**	0	**1**	0
	In-/output		channel 5 (= connector C6)					
Byte 2 (diagnostics)	0	0	**1**	**1**	**1**	0	**1**	0
	bit-oriented		SCSx (0×1A)					

3 TBDP-L2-8DIP-8DOP:
Overcurrent (SCOx) at output 5, connector C3:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Header)	**1**	0	0	0	0	0	0	**1**
	channel rel. diag.		Slot 1 (= overcurrent diagnostics)					
Byte 1 (channel)	**1**	0	0	0	**1**	0	**1**	0
	output		channel 6 (= output 5)					
Byte 2 (diagnostics)	0	0	**1**	**1**	**1**	0	**1**	0
	bit-oriented		SCOx (0×01)					

7.4 Parameterization

7.4.1 Station parameters

The station parameters are valid for the whole module.

Table 7-5: Station parameters

A *default setting*

Parameter name	Value	Meaning
Output behavior at communication loss	00 = set to 0 **A**	The station switches the outputs to "0". No error information is transmitted.
	10 = keep last value	The station maintains the actual output data.
Deactivate all diagnostics	0 = no **A**	Diagnostic messages and alarms are generated.
	1 = yes	Diagnostic messages and alarms are generated.
Deactivate load voltage diagnostics	0 = no **A**	The monitoring of the load voltage V_2 is activated.
	1 = yes	An under voltage at V_2 is not monitored.

7.4.2 Parameters for I/O channels

Table 7-6: Parameters for I/O channels

A *default setting*

Parameter name	Value	Meaning
Invert digital input (Inv. DIx)	0 = no **A**	
	1 = yes	The input signal is inverted.
Manual output reset after overcurrent (SROx)	0 = no **A**	The output switches on automatically after an overload.
	1 = yes	The output is manually switched-off and on again.
Activate output (EN DOx)	0 = no	
	1 = yes **A**	
Pulse stretching input (*10 ms)	The input signal is stretched. The input signal is stretched to a time between 0 to 255 in steps of [ms]. Default setting: 0 0 = pulse stretching deactivated Example: Pulse stretching 10 = 100 ms pulse	

8 The web server

8.1 IP address

Open the web server by entering the device's IP-address in your web browser.

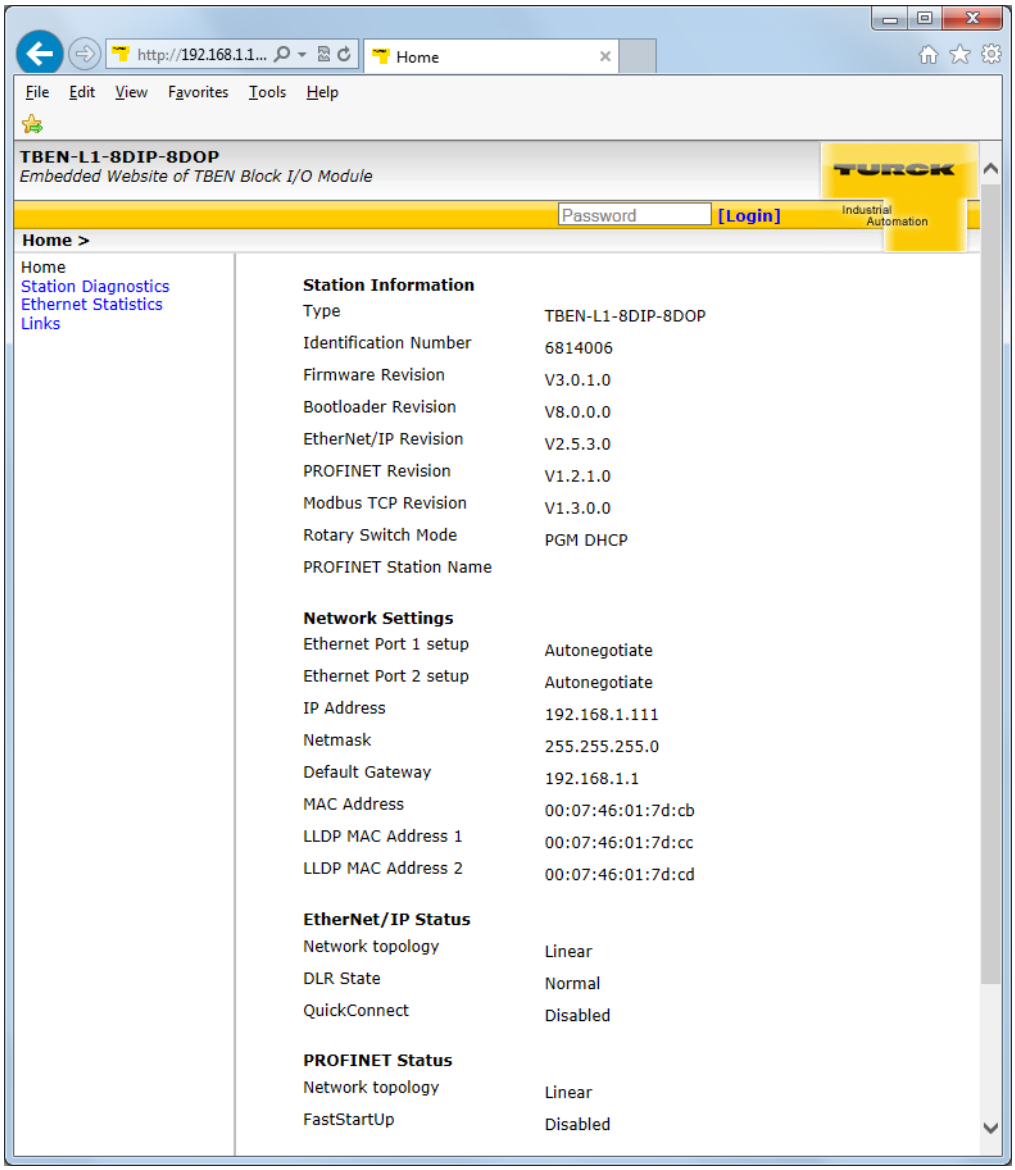
IF no IP-address is assigned to the device (DHCP-, BootP-server etc.), then the web server can be opened using the default IP-address 192.168.1.254.

8.2 Start page of the web server (Home)

The start page of the web server shows general device information, network settings etc..

The menu items "Station Diagnostics", "Ethernet Statistics" and "Links" can be accessed without administrator access.

Figure 8-1: Start page of the TBEN-L web server



8.3 Station Diagnostics

Diagnostic messages of the device are displayed on the "Station Diagnostics"-page.

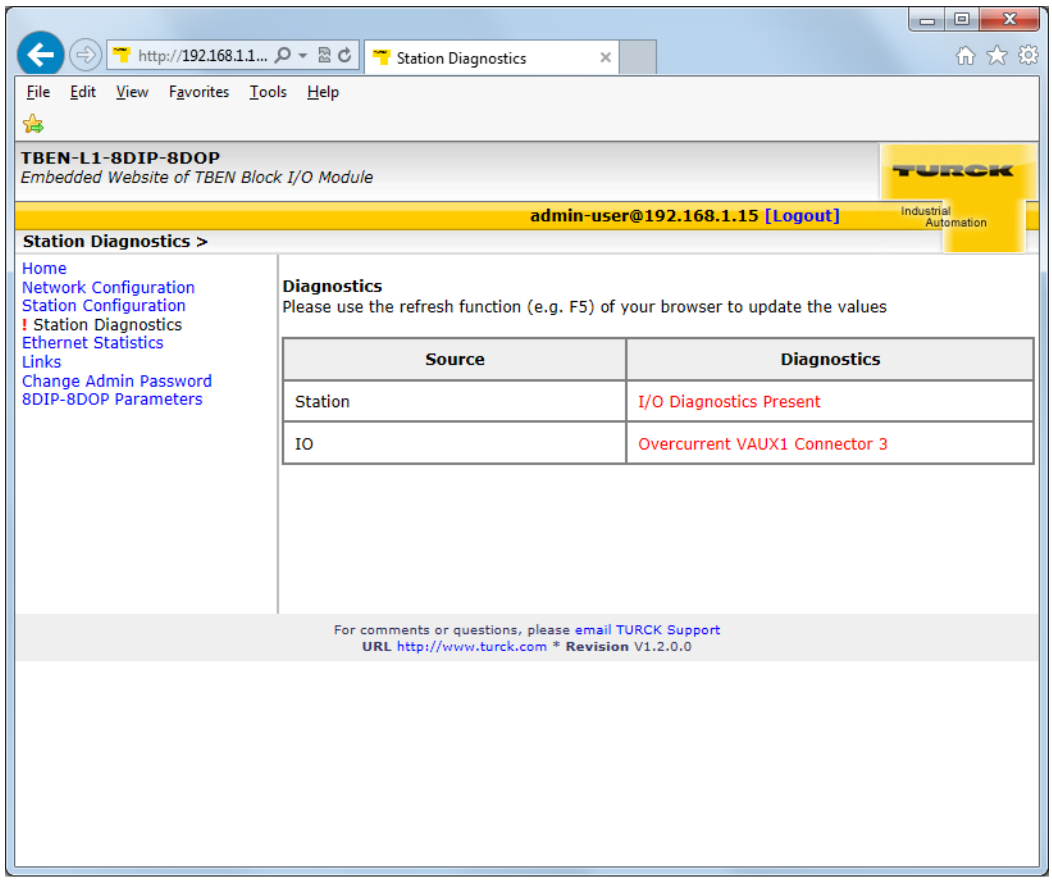
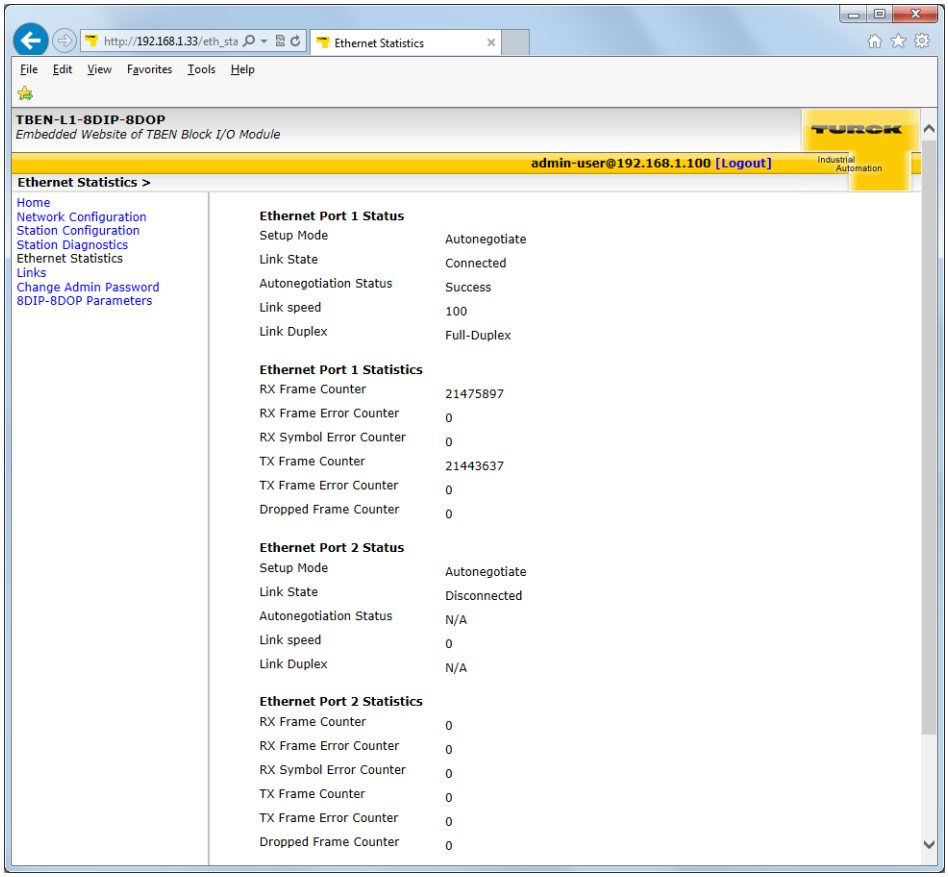


Figure 8-2: Diagnostics in the web server

8.4 Ethernet Statistics

The page "Ethernet Statistics" shows information like the port-status, telegram and error counters etc. The page can above all be useful for analyzing network problems.

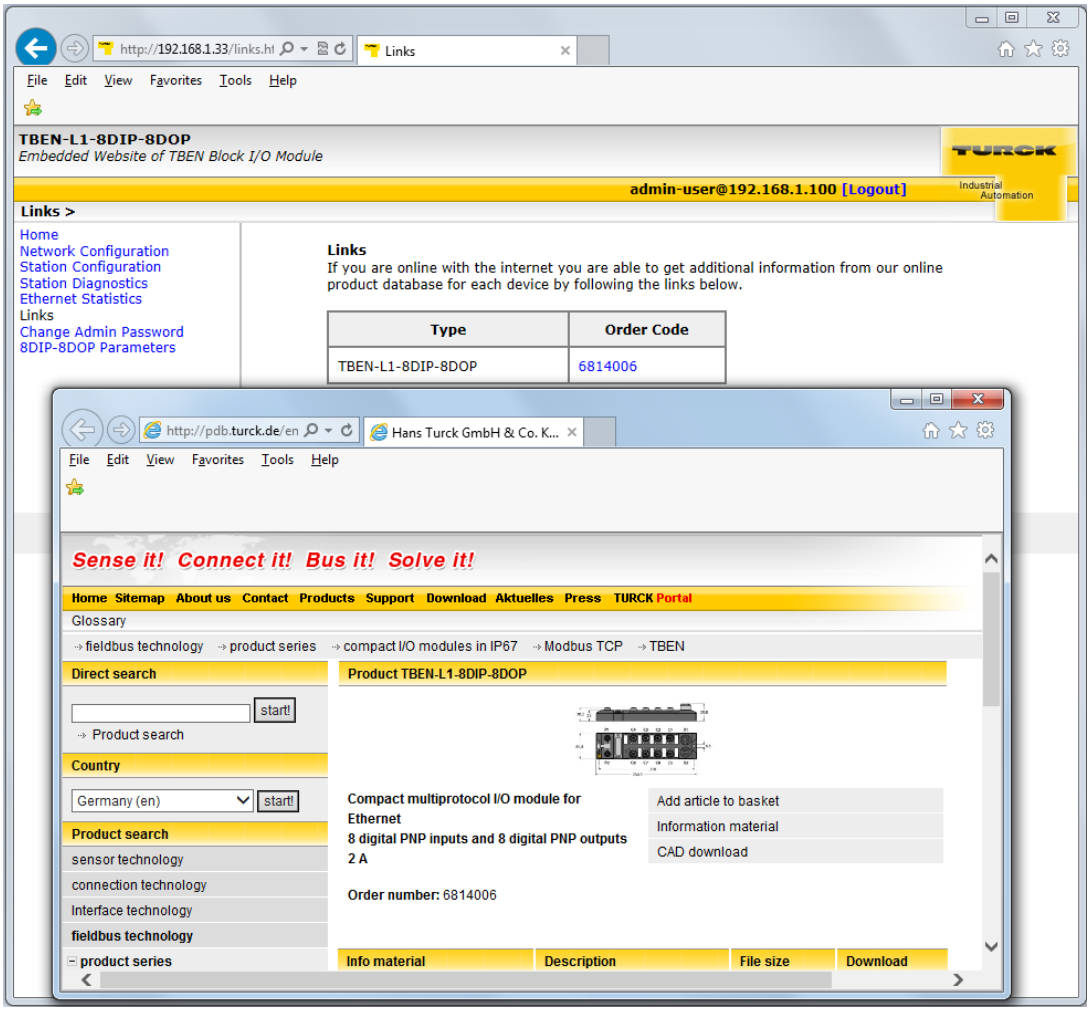
Figure 8-3: Ethernet Statistics



8.5 Links

This page contains for example a link to the product page on the TURCK-website.

Figure 8-4: Links



8.6 Login / password

In order to get access to the extended functions of the web server (Network Configuration, Station Configuration, etc.), you have to log-in to the web server as administrator.

For the first login use the default password "password".

The default-password should be changed by the administrator. To do so, please follow the instructions under Change Admin Password (Seite 8-8).

NOTE

A reset of the device to the default-settings using the switch position 900 "F_Reset" also causes a reset of the password to "password".

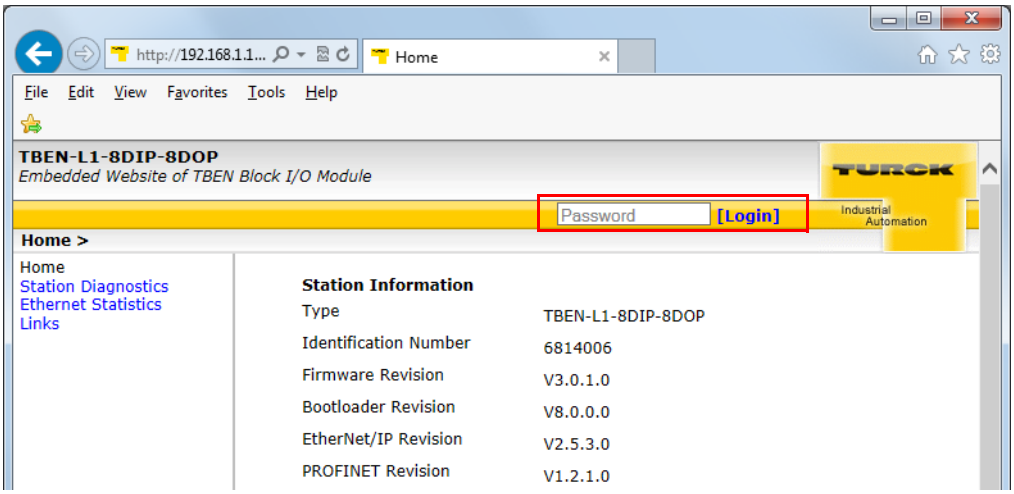


Figure 8-5: Web server "Home" screen

8.7 Change Admin Password

NOTE

For security aspects when working with the web server, please observe the notes under Sicherheit im Webserver (Seite 2-2).

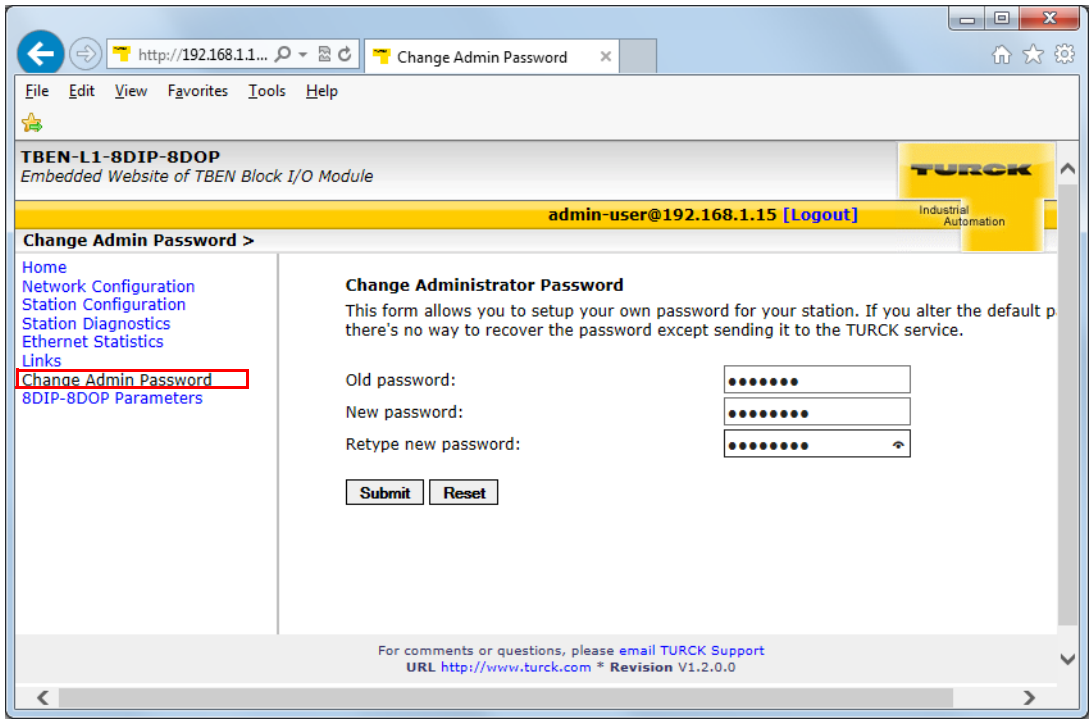
Please define an individual password for administrator rights.

Default-password: „password“

NOTE

A reset of the device to the default-settings using the switch position 900 „F_Reset“ (see also Werkseinstellung (F_Reset), Schalterstellung „900“ (Seite 6-6)) or the Button „Reset to Factory Defaults“ (see also Reset to Factory Defaults (Seite 8-11)) also resets the password to "password“.

Figure 8-6: Change Admin Password



Change password

➤ Change the password for the web server in the web server mask.

➤ Write the changes into the device via "Submit".

➤ Restart the device (power cycle or pressing the set button).

➥ The device has accepted the new settings, the settings are active

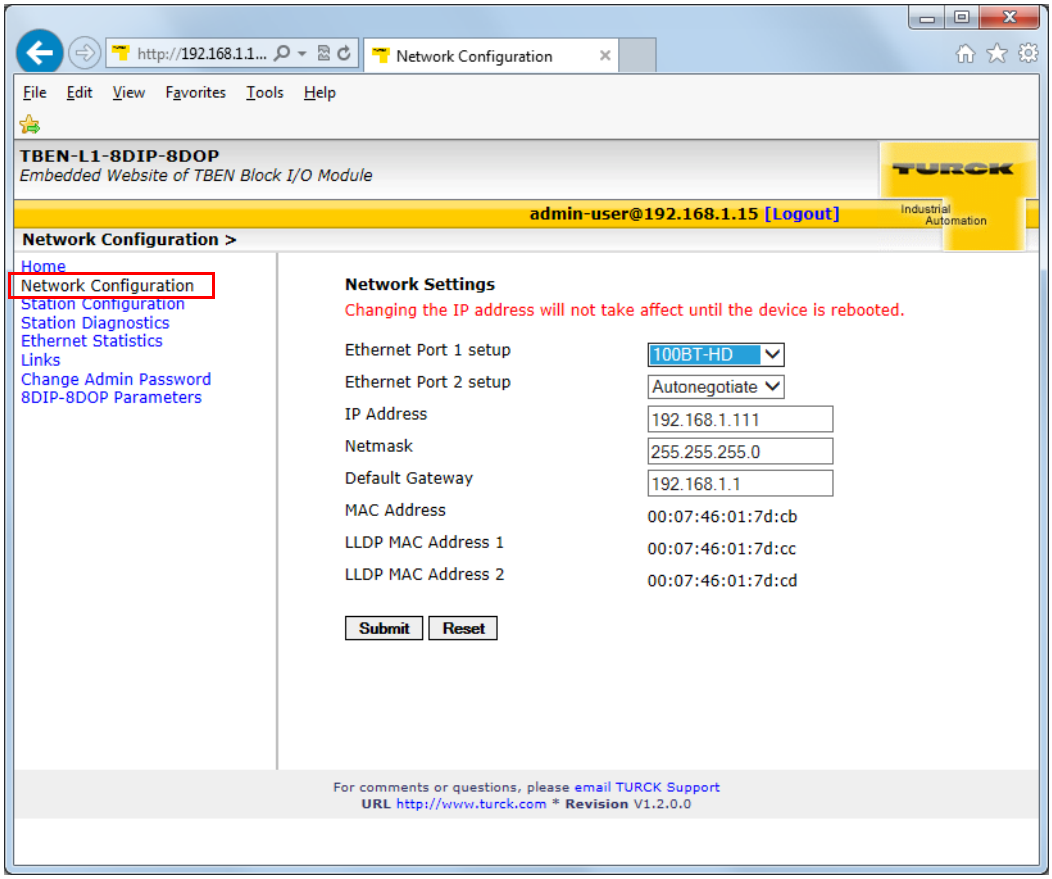
NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

8.8 Network Configuration

On the "Network Configuration"-page, network-relevant settings can be changed.

Figure 8-7: Web server "Network Configuration"



8.8.1 Change network parameters (port settings, IP address, etc.)

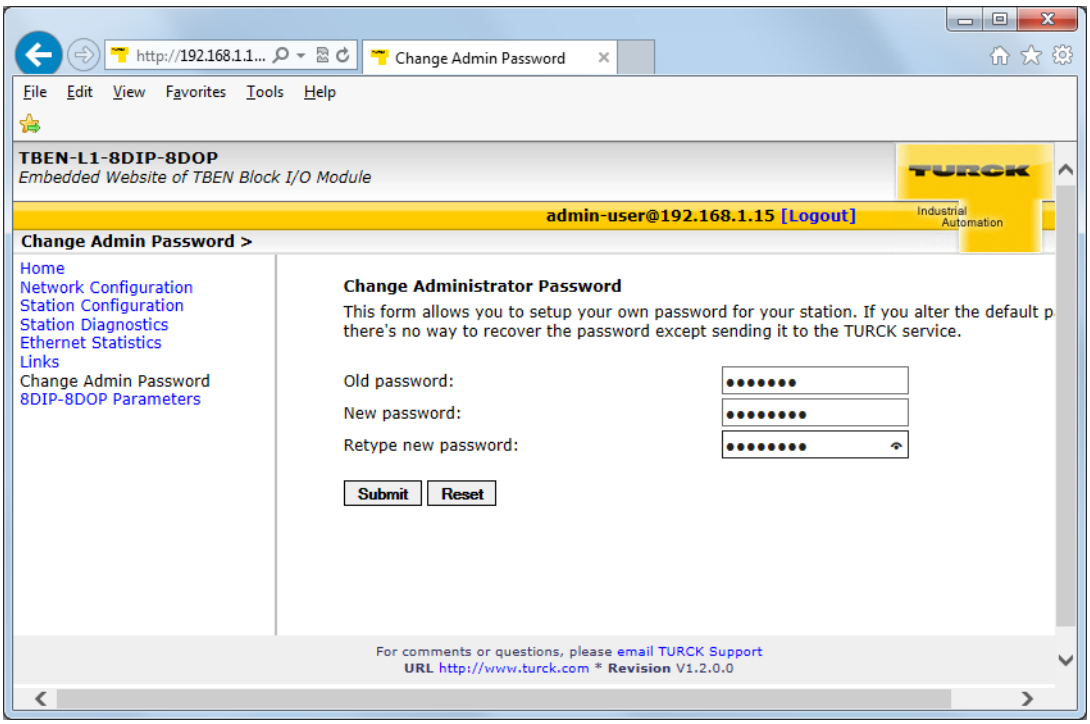
The device's network settings can be changed under "Network Configuration" only by users having administrator rights.

NOTE

The access of the web server to the station is only possible, if the station already has an IP address, Adressierung Ethernet (Seite 6-3).

and if it is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode.

Figure 8-8: Web server with network configuration



Change network parameters

➤ Change the network parameters in the web server mask

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings are active

NOTE

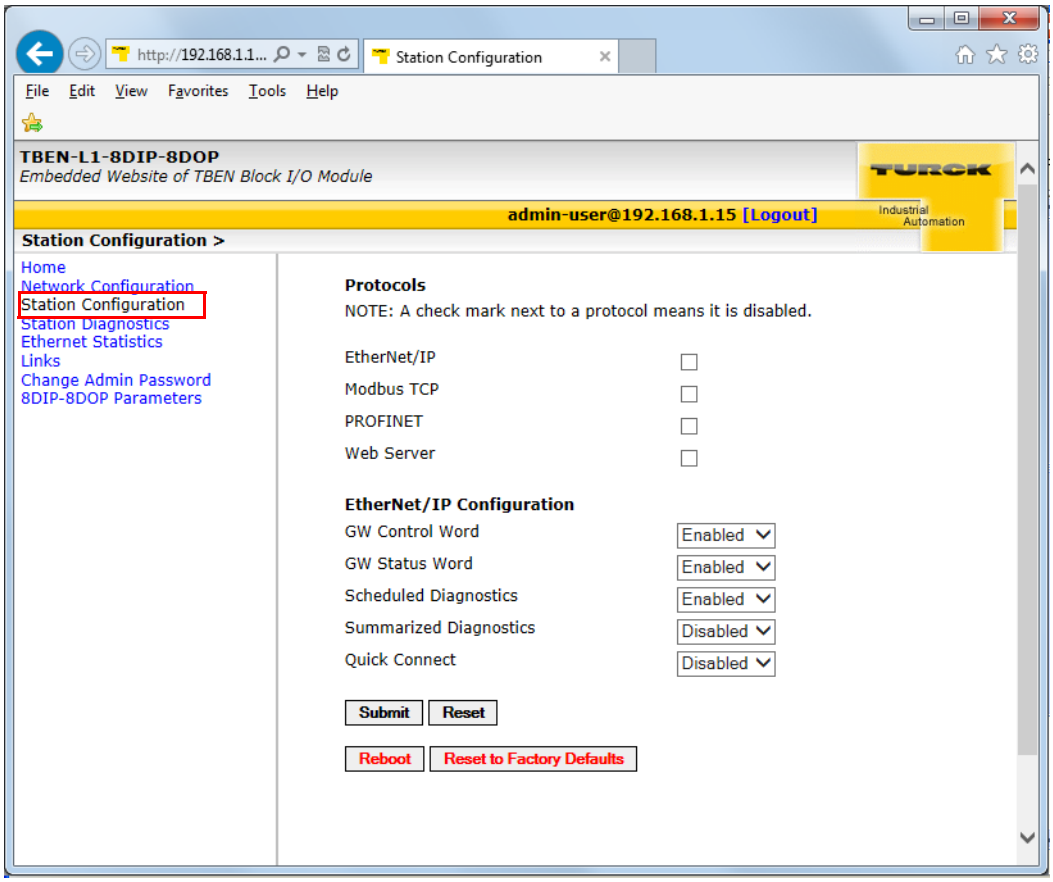
"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

8.9 Station Configuration

8.9.1 Configuration of the field bus interface

The "Station Configuration"-page serves for parameterizing the device's field bus interface.

Figure 8-9: Web server "Station Configuration"



Station configuration

- ➤ Change the station configuration in the web server mask
- ➤ Write the changes into the device via "Submit".
- ➥ The device has accepted the new settings, the settings are active

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

Reboot

"Reboot" executes a power-cycle at the device.

Reset to Factory Defaults

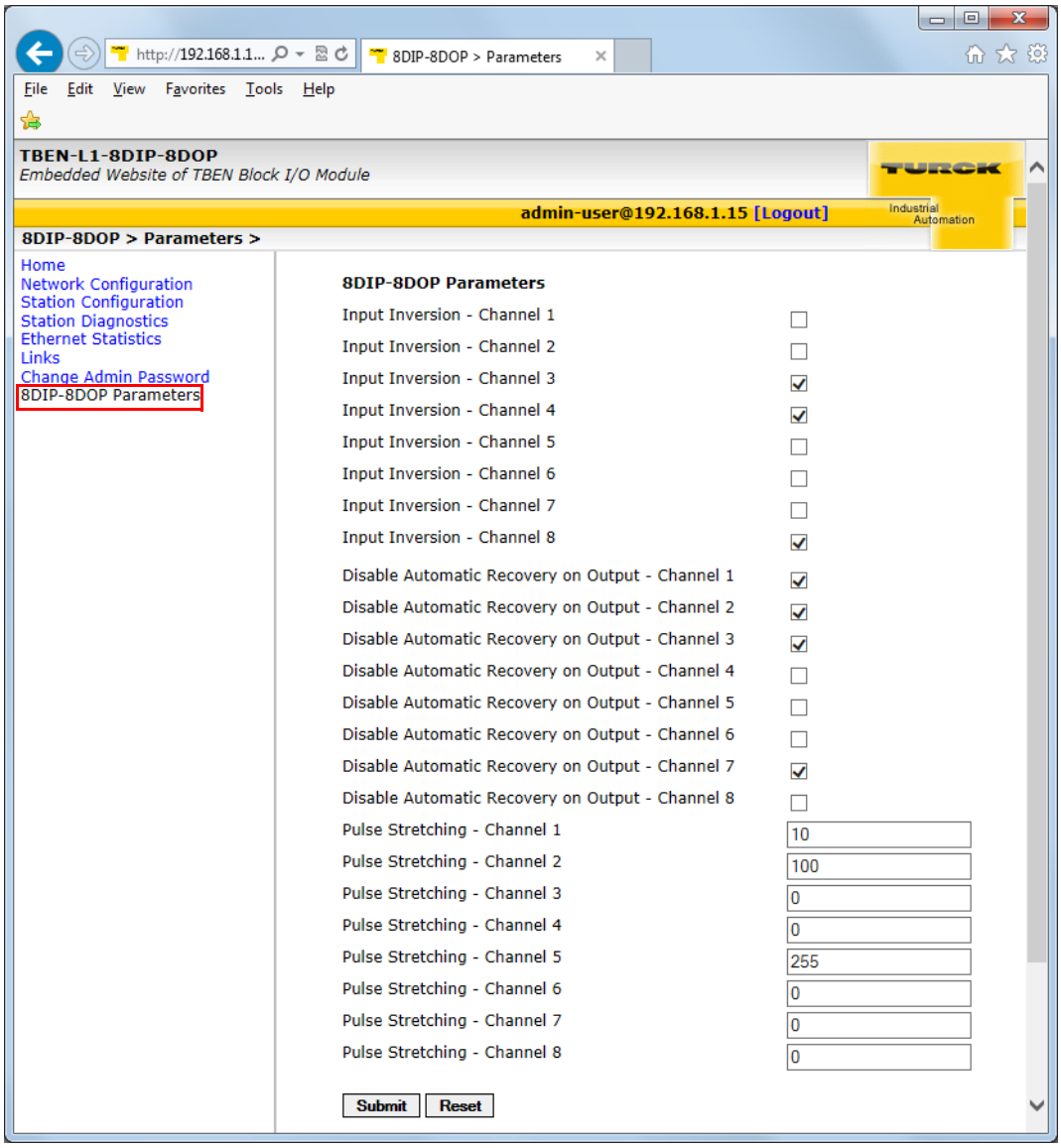
This function corresponds to switch position 900, see also Factory reset (F_Reset), switch position „900“ (Seite 6-6).

8.10 I/O-parameters

8.10.1 Parameterization of the in-/ outputs

The "Parameters"-page is used to parameterize the station's I/O-channels.

Figure 8-10: Web server "Parameters"



Change parameters

- ➤ Change the parameters for the station in the web server mask.
- ➤ Write the changes into the device via "Submit".
- ➤ Restart the device (power cycle or pressing the set button).
- ➥ The device has accepted the new settings, the settings are active

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

9 Access via I/O-ASSISTANT 3 (FDT/DTM), PACTware

9.1 General

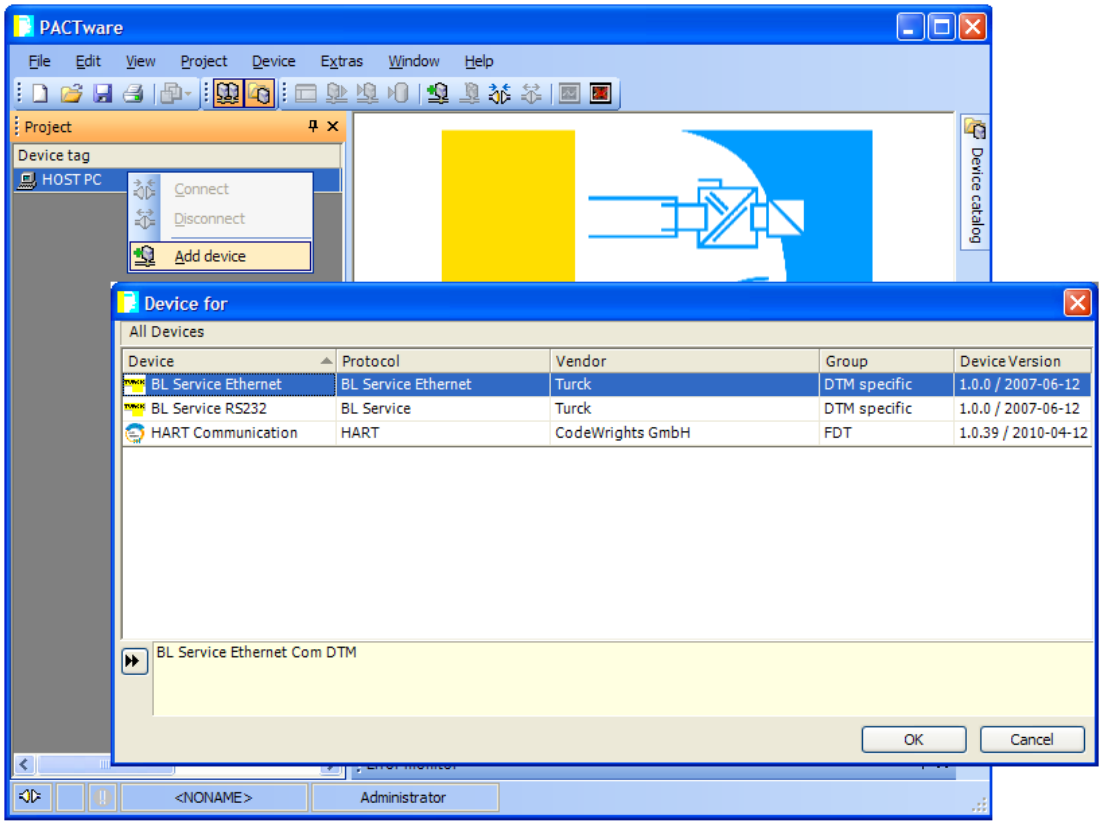
The access to the TBEN-L modules using the I/O-ASSISTANT V3 (FDT/DTM), the TURCK PACTware™-DTMs,is done via Ethernet.

9.1.1 Addressing via I/O-ASSISTANT 3 (FDT/DTM)

The software-tool I/O-ASSISTANT enables direct access to the Ethernet-network via the Ethernet cable.

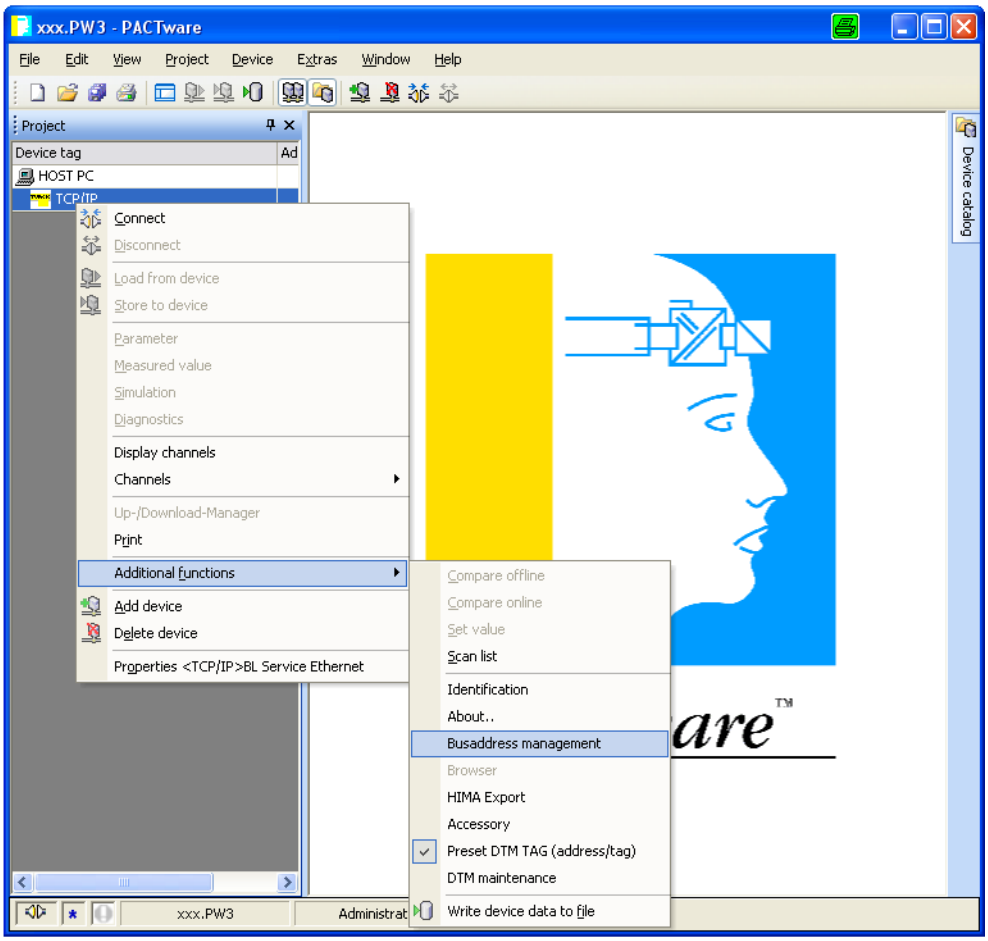
The IP address, as well as the subnet mask of the TURCK Ethernet stations, can be changed accordingto the application by using the Busaddress Management function of the BL Service Ethernet interface (TCP/IP) in the software I/O-ASSISTANT.

Figure 9-1: BL Service Ethernet



1 Open the Busaddress management via roght-click onto the TCP/IP interface using "Additional functions→ Busaddress management".

Figure 9-2: Busaddress management



2 The "search" function in the busaddress management searches the network for TURCK Ethernet devices.

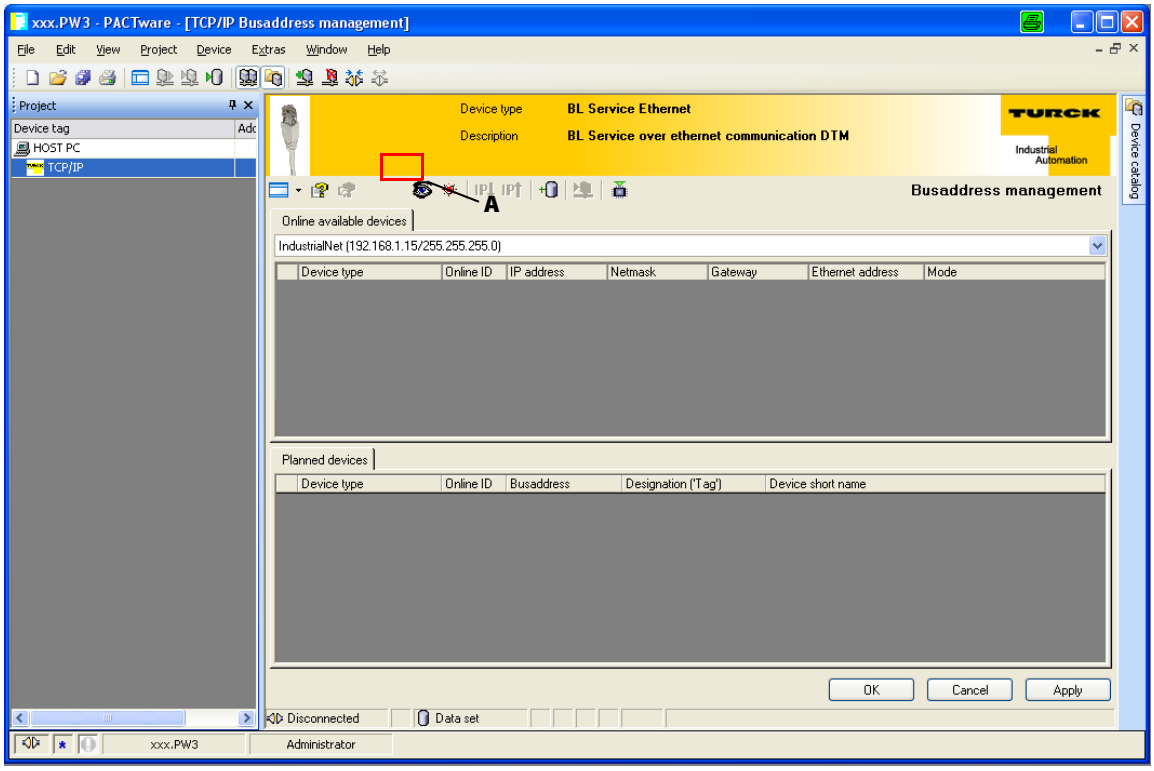


Figure 9-3: Searching network-Nodes in the Busaddress management

A *Search function in the Busaddress management*

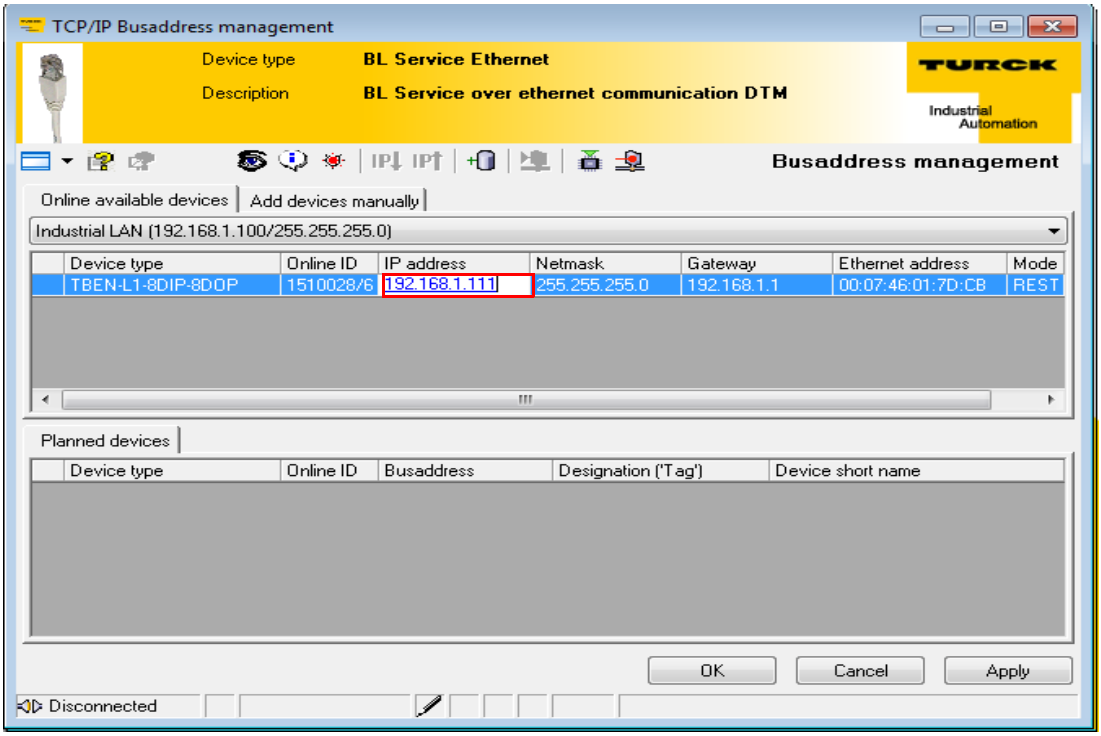
NOTE

The access of the IO-ASSISTANT to the station is only possible, if the station already has an IP-address (see Adressierung Ethernet (Seite 6-3))

and if it is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode.

3 Assign the desired IP address to the node and write it down to the device using the "Apply" button.

Figure 9-4: IP address change



NOTE

When using Windows XP as operating system, difficulties may occur with system-integrated firewall.

It may inhibit the access of PACTware™ (I/O-ASSISTANT V3) to the Ethernet-network. In this case, please adapt your firewall respectively or deactivate it.

10 Guidelines for Electrical Installation

10.1 General notes

10.1.1 General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

10.1.2 Cable routing

Correct cable routing prevents or suppresses the reciprocal influencing of parallel routed cables.

Cable routing inside and outside of cabinets

To ensure EMC-compatible cable routing, the cables should be grouped as follows:

Various types of cables within the groups can be routed together in bundles or in cable ducts.

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage ≤ 60 V,
- unshielded cables for AC voltage ≤ 25 V,

Group 2:

- unshielded cables for DC voltage > 60 V and ≤ 400 V,
- unshielded cables for AC voltage> 25 V and ≤ 400 V,

Group 3:

- unshielded cables for DC and AC voltages > 400 V.

The following group combination can be routed only in separate bundles or separate cable ducts (no minimum distance apart):

- Group 1/Group 2

The group combinations:

Group 1/Group 3 and Group 2/Group 3

must be routed in separate cable ducts with a minimum distance of 10 cm apart. This is equally valid for inside buildings as well as for inside and outside of switchgear cabinets.

Cable routing outside buildings

Outside of buildings, cables should be routed in closed (where possible), cage-type cable ducts made of metal. The cable duct joints must be electrically connected and the cable ducts must be earthed.

WARNING!

Cable routing outside buildings

Warning about danger of life due to wrong laying of cables

➤ Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

10.1.3 Lightning protection

The cables must be routed in double-grounded metal piping or in reinforced concrete cable ducts.

Signal cables must be protected against over voltage by varistors or inert-gas filled over voltage arrestors. Varistors and over voltage arrestors must be installed at the point where the cables enter the building.

10.1.4 Transmission media

NOTE

TURCK offers a variety of cable types for field bus lines as premoulded or bulk cables with different connectors.

The ordering information on the available cable types can be taken from the BL20-catalog.

10.2 Electromagnetic compatibility (EMC)

The TURCK products comply in full with the requirements pertaining to EMC regulations. Nevertheless, an EMC plan should be made before installation.

Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

10.2.1 Ensuring electromagnetic compatibility

The EMC of the stations is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices. The grounding lug at the Ethernet-connectors has to be connected as low-impedance as possible to earth.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

10.2.2 Grounding of inactive metal components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, tophat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.
- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

WARNING!

Grounding of inactive metal components
Dangerous contact voltage
➤ Connect earth to the protective conductor

10.2.3 PE connection

A central connection must be established between ground and PE connection (protective earth).

10.3 Shielding of cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80 %.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

NOTE

When installing, please pay attention to the following...

- the shield should be connected immediately when entering the system,
- the shield connection to the shield rail should be of low impedance,
- the stripped cable-ends are to be kept as short as possible,
- the cable shield is not to be used as a bonding conductor.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is used in stationary operation The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

NOTE

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.

A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

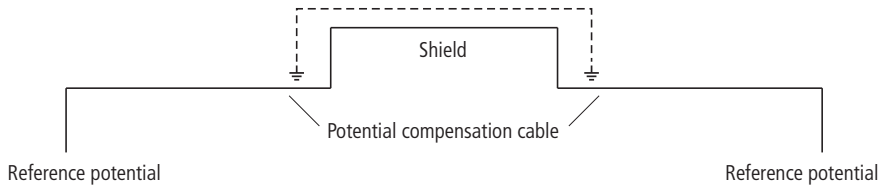
10.4 Potential compensation

Potential differences can occur between installation components that are in separate areas if these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

A potential-compensation cable must be routed to the potential compensation.

Figure 10-1: potential compensation



A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10% of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 /0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible.

10.4.1 Switching inductive loads

In the case of inductive loads, a protective circuit on the load is recommended.

10.4.2 Protection against Electrostatic Discharge (ESD)

ATTENTION!

Exposed metal contacts

Material damage due to electrostatic discharge

➤ Avoid to touch the metallic contacts with bare hands

11 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable Logic Controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (Bit/s).

Baud rate

Unit of measurement for measuring data transmission speeds in Bit/s.

Bidirectional

Working in both directions.

BootP

Short for Bootstrap-protocol. The Bootstrap-protocol is used to set the network address of network nodes by means of a boot server.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, for example, parallel-routed signal cables, contactors and electrostatic discharges.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O modules of a station.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

D

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Field bus

Data network on sensor/actuator level. A field bus connects the equipment on the field level. Characteristics of a field bus are a high transmission security and real-time behavior.

G

GND

Abbreviation of ground (potential "0").

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

GSD

Acronym for Electronic Device Data Sheet which contains standardized PROFIBUS DP station descriptions. They simplify the planning of the DP master and slaves. Default language is English.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0... 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then "waver" at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

L

Load value

Predefined value for the counter module with which the count process begins.

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant Bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Master/slave mode

Mode of operation in which a station acting as a master controls the communication between other stations in a bus system.

Module bus

The module bus is the internal bus in a BL20 station. The BL20 modules communicate with the gateway via the module bus which is independent of the field bus.

MSB

Most Significant Bit

Multi-master mode

Operating mode in which all stations in a system communicate with equal rights via the bus.

N

NAMUR

German acronym for an association concerned with standardizing measurement and control engineering. NAMUR initiators are special versions of the two-wire initiators. NAMUR initiators are characterized by their high immunity to interference and operating reliability, due to their special construction (low internal resistance, few components and compact design).

O

Overhead

System administration time required by the system for each transmission cycle.

P

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O modules of the control and load circuits.

PROFIBUS-DP

PROFIBUS bus system with DP protocol. DP stands for decentralized periphery. PROFIBUS-DP is based on DIN 19245 Parts 1 + 3 and has been integrated into the European field bus standard EN 50170.
It ensures a fast cyclic data exchange between the central DP master and the decentralized periphery devices (slaves). Its universal use is realized by the multi master concept.

PROFIBUS-DP address

Each PROFIBUS-DP module is assigned an explicit PROFIBUS-DP address, with which it can be queried by the master.

PROFIBUS-DP master

The PROFIBUS-DP master is the central station on the bus and controls access of all stations to PROFIBUS.

PROFIBUS-DP slave

PROFIBUS-DP slaves are queried by the PROFIBUS-DP master and exchange data with the master on request.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are for example, sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g. radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

The phase and the amplitude of the electric data signals are regenerated during the transmission process by the repeater. Further, it is possible to change the topology of the PROFIBUS network. It can be extended considerably by means of the repeater.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

SUB-D connector

9-pin connector for connecting the field bus to the I/O-stations.

T

Terminating resistor

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UART

Universal Asynchronous Receiver/Transmitter. UART is a logic circuit which is used to convert an asynchronous serial data sequence to a parallel bit sequence or vice versa.

Unidirectional

Working in one direction.

12 Index

W